

TECHNICAL SPECIFICATIONS

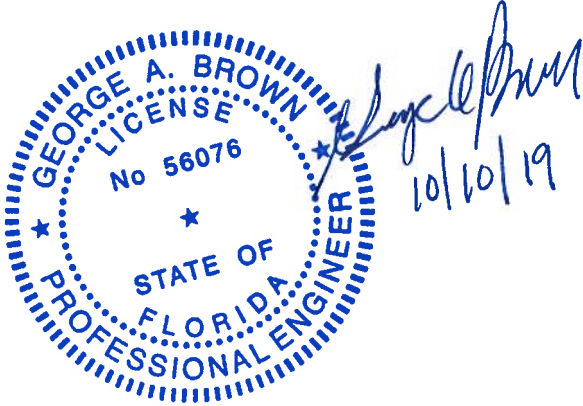
PRODUCTION WELL PW-9



**Department of Public Works
Utilities Division
630 NW 2nd Street
Hallandale Beach, FL 33009**

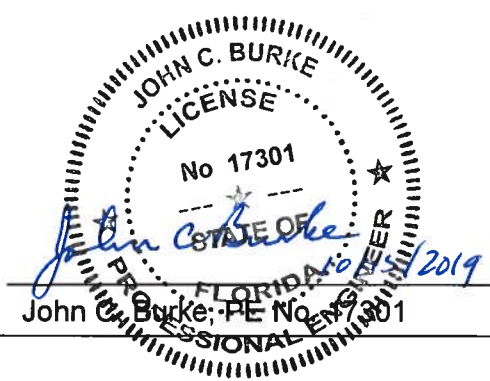
**Bid Set
February 2020**

Engineering Index Sheet for Specifications¹
General, Civil and Mechanical

Project Name: City of Hallandale Beach Production Well PW-9	Project Address: 430 Ansin Blvd Hallandale Beach, FL 33009
Person in Responsible Charge: George A. Brown, PE Florida PE No. 56076 4000 Hollywood Blvd., Suite No. 750N Hollywood, Florida 33021	Specification Responsibility: Division 1 Division 2 Division 9 Division 10 Division 11 Division 12 Division 15
Duly Authorized Engineering Business: Hazen and Sawyer, PC 4000 Hollywood Blvd., Suite No. 750N Hollywood, Florida 33021 Certificate of Authorization No.: 2771	
Florida Building Code Compliance: 6 th Edition (2017) Florida Building Code, Plumbing	
Software Used in Specification Development: Microsoft Word	
<div style="text-align: center;"></div> <div style="text-align: center; margin-top: 20px;">_____ George A. Brown, PE No. 56076</div>	

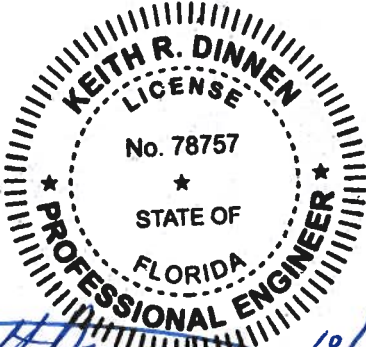
¹ This sheet complies with the requirements of Florida Administrative Code 61G15-23.001(4)(b).

Engineering Index Sheet for Specifications¹
Electrical

Project Name: City of Hallandale Beach Production Well PW-9	Project Address: 430 Ansin Blvd Hallandale Beach, FL 33009
Person in Responsible Charge: John C. Burke, PE Florida PE No. 17301 6675 Corporate Center Pkwy Suite 330 Jacksonville, FL 32216	Specification Responsibility: Division 16
Duly Authorized Engineering Business: Hazen and Sawyer, PC 4000 Hollywood Blvd., Suite No. 750N Hollywood, Florida 33021 Certificate of Authorization No.: 2771	
Florida Building Code Compliance: 6 th Edition (2017) Florida Building Code, Building	
Software Used in Specification Development: Microsoft Word	
 John C. Burke, PE No. 17301	

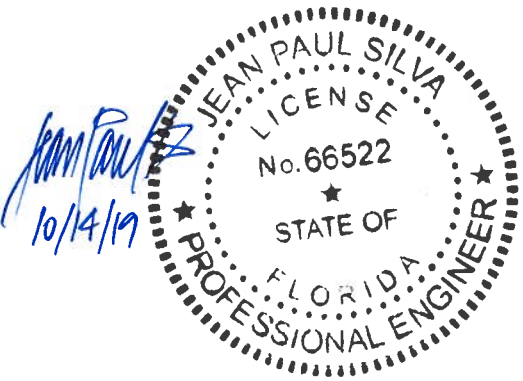
¹ This sheet complies with the requirements of Florida Administrative Code 61G15-23.001(4)(b).

Engineering Index Sheet for Specifications¹
Instrumentation / Controls

Project Name: City of Hallandale Beach Production Well PW-9	Project Address: 430 Ansin Blvd Hallandale Beach, FL 33009
Person in Responsible Charge: Keith R. Dinnen, PE Florida PE No. 78757 4000 Hollywood Blvd., Suite No. 750N Hollywood, Florida 33021	Specification Responsibility: Division 17
Duly Authorized Engineering Business: Hazen and Sawyer, PC 4000 Hollywood Blvd., Suite No. 750N Hollywood, Florida 33021 Certificate of Authorization No.: 2771	
Florida Building Code Compliance: Not Applicable	
Software Used in Specification Development: Microsoft Word	
 <i>Keith R. Dinnen</i> 10/10/2019 Keith R. Dinnen, PE No. 78757	

¹ This sheet complies with the requirements of Florida Administrative Code 61G15-23.001(4)(b).

Engineering Index Sheet for Specifications¹
Structural

Project Name: City of Hallandale Beach Production Well PW-9	Project Address: 430 Ansin Blvd Hallandale Beach, FL 33009
Person in Responsible Charge: Jean Paul Silva, PE Florida PE No. 66522 2101 Corporate Blvd NW # 301 Boca Raton, FL 33431	Specification Responsibility: Division 3 Division 5
Duly Authorized Engineering Business: Hazen and Sawyer, PC 4000 Hollywood Blvd., Suite No. 750N Hollywood, Florida 33021 Certificate of Authorization No.: 2771	
Florida Building Code Compliance: 6 th Edition (2017) Florida Building Code, Building 6 th Edition (2017) Florida Fire Prevention Code	
Software Used in Specification Development: Microsoft Word	
<div style="text-align: center;"></div> <div style="text-align: center; margin-top: 20px;"><hr style="width: 30%; margin: 0 auto;"/>Jean Paul Silva, PE No. 66522</div>	

¹ This sheet complies with the requirements of Florida Administrative Code 61G15-23.001(4)(b).

BID PROPOSAL FORM
CITY OF HALLANDALE BEACH
PRODUCTION WELL PW-9

TO THE COMMISSION OF THE CITY OF
HALLANDALE BEACH, FLORIDA

Ladies and Gentlemen:

The undersigned bidder proposes to furnish all labor, tools, material and supplies, and to sustain all the expense incurred in doing the work set forth below that may be awarded the undersigned by the City of Hallandale Beach, Florida, through its proper officers, and to do the same strictly in accordance with the plans and contract documents on file in the Office of the City Engineer of Hallandale Beach, which are referred to below and made a part hereof, at the following combination of lump sum prices:

BASE BID

<u>Item No.</u>	<u>Estimated Quantity</u>	<u>Description</u>	<u>Total</u>
1	Lump Sum	Mobilization and demobilization for the lump sum price of: _____ _____ Dollars and _____ Cents	\$ _____
<u>NOTE:</u> The total for Bid Item No. 1 shall not exceed 10% of the total base bid price.			
2	Lump Sum	Performance and payment guaranty and insurance for the lump sum price of: Twenty-Five - - - - - Dollars and No- - - - - Cents	\$ _____
<u>NOTE:</u> The total for Bid Item No. 2 shall not exceed 5% of the total base bid price.			
3	Lump Sum	Consideration for Indemnification for the lump sum price of: Twenty-Five - - - - - Dollars and No- - - - - Cents	\$ <u>25.00</u>

BID PROPOSAL FORM
CITY OF HALLANDALE BEACH
PRODUCTION WELL PW-9

<u>Item No.</u>	<u>Estimated Quantity</u>	<u>Description</u>	<u>Total</u>
4	Allowance	Permit Fees Allowance of: <u>One-Hundred Thousand - - - - -</u> <u>- - - - -</u> Dollars and <u>No- - - - -</u> Cents	 <u>\$50,000.00</u>
5	Allowance	Utility Relocation Allowance of: <u>Fifty Thousand - - - - -</u> <u>- - - - -</u> Dollars and <u>No- - - - -</u> Cents	 <u>\$50,000.00</u>
6	Allowance	Special Inspector Allowance of: <u>Ten Thousand - - - - -</u> <u>- - - - -</u> Dollars and <u>No- - - - -</u> Cents	 <u>\$10,000.00</u>
7	Lump Sum	All Other Work described in the Contract Documents, for the lump sum price of: <u>- - - - -</u> <u>- - - - -</u> Dollars and <u>- - - - -</u> Cents	 <u>\$ - - - - -</u>

The City of Hallandale Beach reserves the right to waive any informality in any bid and to reject any or all bids.

TOTAL BASE BID PRICE FOR PROPOSAL (ITEMS 1 THROUGH 7): \$ - - - - -
(FIGURES)

- - - - - Dollars and

- - - - - Cents

BID PROPOSAL FORM

**CITY OF HALLANDALE BEACH
PRODUCTION WELL PW-9**

AMOUNTS SHALL BE SHOWN ON BOTH WORDS AND FIGURES. IN CASE OF DISCREPANCIES, THE AMOUNT SHOWN IN WORDS SHALL GOVERN FOR EACH BID ITEM AND TOTAL BASE BID.

Bidder acknowledges that included in the various items of the bid proposal and in the TOTAL BASE BID PRICE are costs for complying with the Florida Trench Safety Act, F.S. 553.60 et. seq. The Bidder by signing and submitting the Trench Safety Act Compliance Statement is, in writing, assuring that it will perform any trench excavation in accordance with applicable trench safety standards.

Contract award shall be based upon the total base bid price, as identified above, by the lowest responsive, responsible bidder.

FIRM NAME (PRINT)

BIDDER'S SIGNATURE

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01015	PLASTIC WATER FILLED BARRIRS
01025	MEASUREMENT AND PAYMENT
01030	HURRICANE PREPAREDNESS
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Appendix B – FDOT Pump Station Record Drawings

SECTION 01010 - SUMMARY OF WORK

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The work to be performed under this Contract shall consist of furnishing of all tools, equipment, materials, supplies, manufactured articles, transportation and services, including fuel, power, water, and essential communications, for the performance of all labor, work, testing and/or other operations as required for the fulfillment of the Contract in strict accordance with the Contract Documents. The work shall be complete, and all work, materials, and services not expressly shown or called for in the Contract Documents which may be necessary for the complete and proper execution of the contract in good faith shall be performed, furnished, and/or provided by the CONTRACTOR as though originally so specified or shown, at no increase in cost to the OWNER.
- B. The work is located within the City of Hallandale Beach, as indicated on the Drawings.
- C. Wherever the Contract Documents address a third party, i.e., subcontractor, manufacturer, etc., it is to be considered as the CONTRACTOR through the third party.
- D. Wherever a reference to number of days is noted, it shall be construed to mean calendar days.
- E. The CONTRACTOR is advised that the work described in the contract documents interfaces with a fully operational water treatment facility, which is the principal source of potable water supply for the City of Hallandale Beach. The CONTRACTOR shall be fully responsible for all precautionary measures together with all remediation, cleanup, disinfection, regulatory agency fines and all other labor, materials, and costs associated with any contamination of the potable water supply or interruption of water treatment caused directly or indirectly by the activities of the CONTRACTOR in the performance of the work.
- F. Notwithstanding other indemnification requirements of the Contract Documents, the CONTRACTOR shall also indemnify, defend, and hold harmless the OWNER, the ENGINEER and the OWNER's agents from any and all legal action which may arise from contamination of the potable water supply or interruption of water treatment caused directly or indirectly by the CONTRACTOR in the performance of the work.

1.02 WORK COVERED BY CONTRACT DOCUMENTS

- A. The work of the Contract is generally composed of the following: 1) drilling, developing and testing of Biscayne Aquifer water supply well designated as "PW-9"; 2) furnishing and install all necessary temporary piping and facilities for conveyance of development water to the disposal location shown on the drawings; 3) construction of the wellhead structure; 4) furnishing and installing the wellhead pump, piping, valves, flow meter, electrical and controls as detailed in the Contract Documents for a complete and operable wellhead and 5) demobilize and remobilize, upon completion of the construction (under

a separate contract) of the proposed pipeline connecting well PW-9 to the water treatment plant, and performance of the wellhead startup and testing.

- B. The Work set forth within these bid documents includes the furnishing of all labor, materials, equipment, services and incidentals, including all associated piping, electrical work, control systems, and all appurtenant work, complete, tested and ready for operation, all in conformance with Contract Document requirements.

1.03 WORK BY OTHERS

- A. The CONTRACTOR's attention is directed to the fact that other contractors will conduct other work at the site(s) during the performance of the work under this Contract. The CONTRACTOR shall conduct its operations so as to cause a minimum of interference with the work of such other contractors, and shall cooperate fully with such contractors to provide continued safe access to their respective portions of the site, as required to perform their respective contracts.

- B. Work to be performed on site under other contracts may consist of (but may not necessarily be limited to) any and/or all the following other projects:

1. Raw Water Pipeline from Proposed Well PW-9 to Existing Well PW-8

- C. When two or more contracts are being executed at one time on the same or adjacent areas in such manner that work on one contract may interfere with that on another, the OWNER shall determine the sequence and order of the work. When the territory of one contract is the necessary or convenient means of access for the execution of another contract, such privilege of access or any other reasonable privilege may be granted by the OWNER to the CONTRACTOR so desiring, to the extent, amount, in the manner, and at the times permitted. No such decision as to the method or time of conducting the work or the use or territory shall be made the basis of any claim of delay or damage.
- D. Interference with Work on Utilities: The CONTRACTOR shall cooperate fully with all utility forces of the OWNER or forces of other public or private agencies engaged in the relocation, altering, or otherwise rearranging of any facilities which interfere with the progress of the work, and shall schedule the work so as to minimize interference with said relocation, altering, or other rearranging of facilities.

1.04 OWNER FURNISHED MATERIALS AND/OR EQUIPMENT

- A. Not Used.

1.05 CONTRACTOR USE OF PROJECT SITE

- A. Staging Plan: The CONTRACTOR's use of the project site shall be limited to the area indicated on the Drawings titled "Staging Plan" and "Enlarged Staging Plan".
- B. The CONTRACTOR shall confine its operations within public right-of-way. Storage of equipment and materials, or erection and use of sheds outside of the Contract limits, if such areas are the property of the OWNER, shall be used only with the OWNER's approval.

1.06 OWNER USE OF THE PROJECT SITE

- A. Not Used.

1.07 PERMITS

- A. All permit application fees for CONTRACTOR obtained permits will be paid for by the OWNER. Payment for permit fees will be based upon the actual permit fees required by the CONTRACTOR from the various agencies having jurisdiction for construction of the project, in accordance with the Contract Documents. The CONTRACTOR shall produce documentation verifying the actual cost of permit application fees. Only permit application fees substantiated by the CONTRACTOR and approved by the ENGINEER will be paid by the OWNER.
- B. It shall be the CONTRACTOR's responsibility to secure all permits of every description required to initiate and complete the work under this contract, except permits obtained by the OWNER.
- C. Permits that have been (or will be) obtained by the OWNER or its authorized representative (copies are available to the CONTRACTOR upon request), include the following:
 - 1. Public Drinking Water Facility Construction Permit from the Florida Department of Environmental Protection.
 - 2. Certifications from Broward County necessary to submit for the City of Hallandale Beach Building Department.
 - 3. The OWNER and the ENGINEER will submit the application for the City of Hallandale Beach Building Department. The ENGINEER will address the City of Hallandale Beach Building Department's comments. The CONTRACTOR shall cooperate with the OWNER and the ENGINEER to finalize the City of Hallandale Beach Building Department's application process and be responsible for coordinating with the OWNER to pickup the approved building permit(s).

1.08 FIELD ENGINEERING

- A. Yard piping 2-inches in diameter and smaller that is shown on the yard piping drawings shall be field routed with the assistance of the ENGINEER and OWNER.

1.09 SITE CONDITIONS

- A. The CONTRACTOR acknowledges that it has investigated prior to bidding and satisfied itself as to the conditions affecting the work, including but not restricted to those bearing upon transportation, disposal, handling and storage of materials, availability of labor, water, electric power, roads and uncertainties of weather, river stages, tides, water tables or similar physical conditions at the site, the conformation and conditions of the ground, the character of equipment and facilities needed preliminary to and during prosecution of the work. The CONTRACTOR further acknowledges that it has satisfied itself as to the character, quality and quantity of surface and subsurface materials or obstacles to be

encountered insofar as this information is reasonably ascertainable from an inspection of the site, or any contiguous site, as well as from information presented by the Drawings and Specifications made a part of this Contract, or any other information made available to it prior to receipt of Bids. Any failure by the CONTRACTOR to acquaint itself with the available information will not relieve it from responsibility for estimating properly the difficulty or cost of successfully performing the work. The OWNER assumes no responsibility for any conclusions or interpretations made by the CONTRACTOR on the basis of the information made available by the OWNER.

1.10 DIMENSIONS OF EXISTING FACILITIES

- A. Where the dimensions and locations of existing improvements are of critical importance in the installation or connection of new work, the CONTRACTOR shall verify such dimensions and locations in the field prior to the fabrication and/or installation of materials or equipment, which are dependent on the correctness of such information.

1.11 UTILITY LOCATIONS

- A. To the extent possible, existing utility lines in the project area have been shown as represented on the available record drawings and surveys referenced earlier. However, neither the Owner and/or Engineer guarantee that all lines are shown, or that said lines are in their true location. It shall be the Contractor's responsibility to identify and locate all underground or overhead utility lines or equipment affected by the project. No additional payment will be made to the Contractor because of discrepancies in actual and plan location of utilities and damages suffered as a result thereof of lines shown on the plans.
- B. All overhead, surface or underground structures and/or utilities encountered are to be carefully protected from damage or displacement. All damage to said structures and/or utilities is to be completely repaired within a reasonable time; needless delay will not be tolerated. The OWNER reserves the right to remedy any damage by ordering outside parties to make repairs at the expense of the Contractor. All repairs made by the Contractor are to be made to the satisfaction of the Owner and shall be inspected by a representative of the Owner.
- C. The Contractor shall arrange for positive underground location, relocation or support of utilities where they may be in conflict with or endangered by the proposed Work.
- D. Relocations of existing utilities for the convenience of the Contractor shall be at Contractor expense.

1.12 DIFFERING BELOW GRADE SITE CONDITIONS – NOTIFICATION TO OWNER

- A. The Contractor shall promptly and before such below grade conditions are disturbed, notify the Owner in writing within three days (3) of: (1) subsurface conditions at the site differing materially from those indicated on the drawings, or (2) unknown below grade physical conditions at the site, of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in Work of the character provided for this contract.
- B. The Owner will promptly investigate and if it finds that such below grade conditions do materially so differ and cause an increase or decrease in the Contractor's cost of, or the time required for, performance of any part of the Work under this contract, whether or not

changed as a result of such conditions, an equitable adjustment shall be made and the contract modified in writing accordingly.

- C. No claim of the Contractor under this clause shall be allowed unless the Contractor has given proper written notice to the Owner as required above.
- D. No claim by the Contractor for an equitable adjustment hereunder shall be allowed if asserted after final payment under this contract.

1.13 ADJUSTING EXISTING VALVES, METERS, CATCH BASINS AND MANHOLES

- A. The Contractor shall responsibility coordinate and make all adjustments to existing meters, valves, catch basins and structures otherwise encountered during construction and proposed to remain, to meet all final grades, unless otherwise instructed by the Engineer and/or the respective utility Owner.
- B. As aged record drawings were used in the development of the contract documents, omission or lack of clarity identifying such structures on the drawings does NOT relieve the Contractor from making any and all adjustments as may be deemed necessary. The Contractor shall visit the site prior to bid, thoroughly familiarize itself with all such visible improvements, and include costs to comply with this requirement in its base bid. All costs related to this Work shall be considered included in the Contractor's base bid.

1.14 SURVEYS AND LAYOUT

- A. All work under this Contract shall be constructed in accordance with the lines and grades shown on the Drawings or as directed by the ENGINEER. Elevation of existing ground and appurtenances are believed to be reasonably correct but are not guaranteed to be absolute and therefore are presented only as an approximation. Any error or apparent discrepancy in the data shown or omissions of data required for accurately accomplishing the stake out survey shall be referred immediately to the ENGINEER for interpretation or correction.
- B. The Contractor shall verify existing utility and structure locations and elevations sufficiently ahead of the Work to allow time for any necessary adjustments without delay to the progress of the installation. Costs due to delays occasioned by locations and/or elevations differing from those shown on the Drawings which could have or should have been discovered by timely verification ahead of the Work shall rest solely with the Contractor. No request for additional compensation or Contract time (except for a non-compensable time extension at the sole discretion of the Engineer, whose decision shall be final) resulting from encountering interfering installations not shown, or existing installations differing in location or elevation from that shown, will be considered.
- C. The survey shall be performed by a Professional Land Surveyor in the State of Florida and shall meet the minimum technical standards identified in Chapter 61G17-6, FAC.
- D. Elevations: All elevations shown on the contract drawings of the facility are in North American Vertical Datum (NAVD) of 1988.
- E. Horizontal Locations: State Plane Coordinates shall be based on NAD 1983/90.
- F. All survey work for construction control purposes shall be made by the CONTRACTOR at his expense. The CONTRACTOR shall provide a Licensed Surveyor as Chief of Party,

competently qualified men, all necessary instruments, stakes, and other material to perform the work.

- G. CONTRACTOR shall establish all baselines for the location of the principal component parts of the work together with a suitable number of bench marks and batter boards adjacent to the work. Based upon the information provided by the Contract Drawings, the CONTRACTOR shall develop and make all detail surveys necessary for construction, including slope stakes, batter boards, stakes for all working points, lines and elevations.
- H. CONTRACTOR shall have the responsibility to carefully preserve the bench marks, reference points and stakes, and in the case of destruction thereof by the CONTRACTOR or resulting from his negligence, the CONTRACTOR shall be charged with the expense and damage resulting therefrom and shall be responsible for any mistakes that may be caused by the unnecessary loss or disturbance of such bench marks, reference points and stakes.
- I. Existing or new control points, property markers and monuments that will be or are destroyed during the normal causes of construction shall be reestablished by the CONTRACTOR and all reference ties recorded therefore shall be furnished to the ENGINEER. All computations necessary to establish the exact position of the work shall be made and preserved by the CONTRACTOR.
- J. The ENGINEER may check all or any portion of the work and the CONTRACTOR shall afford all necessary assistance to the ENGINEER in carrying out such checks. Any necessary corrections to the work shall be immediately made by the CONTRACTOR. Such checking by the ENGINEER shall not relieve the CONTRACTOR of any responsibilities for the accuracy or completeness of his work.
- K. At completion of the work, the CONTRACTOR shall furnish Record Drawings indicating the final layout of all piping, electrical duct banks, roads, all structures, existing bench marks, etc. The Record Drawings shall indicate all critical elevations of piping, structures, finish grades, etc.
- L. Submit record drawings in accordance with the requirements of Section 01300 and as herein specified.
- M. The OWNER shall provide the Contractor with three sets of 22" x 34" contract drawings for the sole purposes of preparing red line markups for submittal as record drawings.
- N. Red Line Markups: Submit two sets of 22" x 34" contract drawings neatly marked-up showing all changes from the original drawings as bid, including all Change Orders, alignment changes, depth changes of underground pipes and utilities, all other items that are not the same as they were originally shown. In addition, disciplines (i.e., electrical, instrumentation, mechanical, civil, structural, plumbing, HVAC, irrigation, landscaping, etc.) contract drawings shall be marked-up showing all changes. Furthermore, the markups shall illustrate existing features, such as existing underground utilities, that were not shown on the as bid contract drawings.
- O. Clearly and legibly marking the sets of record drawings is a priority. The Engineer shall review the submitted record drawings for clarity, legibility and that the markups accurately

reflect the authorized changes. The Engineer will reject the record drawing submittal if, in the Engineer's opinion the markups are not sufficiently clear, legible and accurate.

1.15 MAINTENANCE OF RECORD DOCUMENTS

A. General:

1. Promptly following initiation of the project, secure from the OWNER at no cost to CONTRACTOR, three complete sets of Contract Documents. Drawings will be full size (22" x 34").
2. Delete ENGINEER title block and seal from all documents.
3. Label or stamp each record document with title, "RECORD DOCUMENTS," in neat large printed letters.
4. Record information concurrently with construction progress and within 24 hours after receipt of information that change has occurred. Do not cover or conceal Work until required information is recorded. CONTRACTOR is responsible for providing "red-lined" markups of all changes including revised locations of buried features.
5. All underground piping inserts, fittings, piping at 20-foot intervals, and valve locations shall be located by the CONTRACTOR's surveyor per North American Datum NAD 83/90.

B. Preservation:

1. Maintain documents in a clean, dry, legible condition and in good order. Do not use record documents for construction purposes.
2. Make documents available at all times for observation by PCM or ENGINEER.

C. Making Entries on Drawings:

1. Using an erasable colored pencil (not ink or indelible pencil), clearly describe change by graphic line and note as required.
 - a. Color Coding:
 - 1) Green when showing information deleted from Drawings.
 - 2) Red when showing information added to Drawings.
 - 3) Blue and circled in blue to show notes.
2. Date entries.
3. Call attention to entry by "cloud" drawn around area or areas affected.

4. Legibly mark to record actual changes made during construction, including, but not limited to:
 - a. Depths of various elements of foundation in relation to finished first floor data if not shown or where depth differs from that shown.
 - b. Horizontal and vertical locations of existing and new Underground Facilities and appurtenances, and other underground structures, equipment, or Work. Reference to at least two measurements to permanent surface improvements.
 - c. Location of internal utilities and appurtenances concealed in the construction referenced to visible and accessible features of the structure.
 - d. Locate existing facilities, piping, equipment, and items critical to the interface between existing physical conditions or construction and new construction.
 - e. Changes made by Addenda and Field Orders, Work Change Directive, Change Order, Written Amendment, and ENGINEER's written interpretation and clarification using consistent symbols for each and showing appropriate document tracking number.
5. Dimensions on Schematic Layouts: Show on record drawings, by dimension, the centerline of each run of items such as are described in previous subparagraph above.
 - a. Clearly identify the item by accurate note such as "cast iron drain," "galv. water," and the like.
 - b. Show, by symbol or note, vertical location of item ("under slab," "in ceiling plenum," "exposed," and the like).
 - c. Make identification so descriptive that it may be related reliably to Specifications.

D. Coordination with Contractor's Surveyor:

1. CONTRACTOR shall not cover any bends, valves, or fittings installed until they have been located by the Contractor's survey crews for the purpose of preparing Record Drawings. In the event that traffic or safety conditions require that the trench be backfilled prior to location, the CONTRACTOR shall, under the direct supervision of the City Inspector onsite, provide and maintain a minimum of two aboveground physical reference points with distances to the fittings in question. Said reference points shall be maintained for a minimum of 48 hours after backfilling.

2. If the above conditions are not met, for any reason, CONTRACTOR shall bear the cost of potholing the constructed installation to allow for the locations.

1.16 FIRE PROTECTION

- A. CONTRACTOR shall take all necessary precautions to prevent fires at or adjacent to the work, buildings, etc., and shall provide adequate facilities for extinguishing fires which do occur.
- B. When fire or explosion hazards are created in the vicinity of the work as a result of the locations of fuel tanks, or similar hazardous utilities or devices, the CONTRACTOR shall immediately alert the local Fire Marshal, the ENGINEER, and the OWNER of such tank or device. The CONTRACTOR shall exercise all safety precautions and shall comply with all instructions issued by the Fire Marshal and shall cooperate with the OWNER of the tank or device to prevent the occurrence of fire or explosion.

1.17 CHEMICALS

- A. All chemicals used during project construction or furnished for project operation, whether herbicide, pesticide, disinfectant, polymer, or reactant of other classification, must show approval of either the EPA or USDA. Use of all such chemicals and disposal of residues shall be in strict conformance with all applicable rules and regulations.

1.18 FIRST AID FACILITIES AND ACCIDENTS

- A. First Aid Facilities: The CONTRACTOR shall provide at the site such equipment and facilities as are necessary to supply first aid to any of his personnel who may be injured in connection with the work.
- B. Accidents:
 1. The CONTRACTOR shall promptly report, in writing, to the ENGINEER and OWNER all accidents whatsoever out of, or in connection with, the performance of the work, whether on or adjacent to the site, which cause death, personal injury or property damage, giving full details and statements of witnesses.
 2. If death, serious injuries, or serious damages are caused, the accident shall be reported immediately by telephone or messenger to both the OWNER and the ENGINEER.
 3. If any claim is made by anyone against the CONTRACTOR or a Subcontractor on account of any accidents, the CONTRACTOR shall promptly report the facts, in writing, to the ENGINEER and OWNER, giving full details of the claim.

1.19 ULTIMATE DISPOSITION OF CLAIMS BY ONE CONTRACTOR ARISING FROM ALLEGED DAMAGE BY ANOTHER CONTRACTOR

- A. During the progress of the work, other contractors may be engaged in performing other work or may be awarded other Contracts for additional work on this project. In that event,

the CONTRACTOR shall coordinate the work to be done hereunder with the work of such other contractors and the CONTRACTOR shall fully cooperate with such other contractors and carefully fit its own work to that provided under other Contracts as may be directed by the ENGINEER. The CONTRACTOR shall not commit or permit any act which will interfere with the performance of work by any other CONTRACTOR.

- B. If the ENGINEER shall determine that the CONTRACTOR is failing to coordinate his work with the work of the other contractors as the ENGINEER directed, then the OWNER shall have the right to withhold any payments otherwise due hereunder until the CONTRACTOR completely complies with the ENGINEER's directions.
- C. If the CONTRACTOR notifies the ENGINEER in writing that another CONTRACTOR is failing to coordinate his work with the work of this Contract as directed, the ENGINEER will promptly investigate the charge. If the ENGINEER finds it to be true, he will promptly issue such directions to the other CONTRACTOR with respect thereto as the situation may require. The OWNER, the ENGINEER, nor any of their agents shall not, however, be liable for any damages suffered by the CONTRACTOR by reason of the other contractor's failure to promptly comply with the directions so issued by the ENGINEER, or by reason of another contractor's default in performance, it being understood that the OWNER does not guarantee the responsibility or continued efficiency of any CONTRACTOR.
- D. The CONTRACTOR shall indemnify and hold the OWNER, and the ENGINEER harmless from any and all claims of judgments for damages and from costs and expenses to which the OWNER may be subjected or which it may suffer or incur by reason of the CONTRACTOR's failure to comply with the ENGINEER's directions promptly.
- E. Should the CONTRACTOR sustain any damage through any act or omission of any other CONTRACTOR having a Contract with the OWNER for the performance of work upon the site or of work which may be necessary to be performed for the proper execution of the work to be performed hereunder, or through any act or omission of a Subcontractor of such Contract, the CONTRACTOR shall have no claim against the OWNER or the ENGINEER for such damage, but shall have a right to recover such damage from the other CONTRACTOR under the provision similar to the following provisions which have been or will be inserted in the Contracts with such other contractors.
- F. Should any other CONTRACTOR having or who shall hereafter have a Contract with the OWNER for the performance of work upon the site sustain any damage through any act or omission of the CONTRACTOR hereunder or through any act or omission of any Subcontractor of the CONTRACTOR, the CONTRACTOR agrees to reimburse such other CONTRACTOR for all such damages and to defend at his own expense any suit based upon such claim and if any judgment or claims against the OWNER shall be allowed, the CONTRACTOR shall pay or satisfy such judgment or claim and pay all costs and expenses in connection therewith and shall indemnify and hold the OWNER harmless from all such claims.
- G. The OWNER's right to indemnification hereunder shall in no way be diminished, waived or discharged, by its recourse to assessment of liquidated damages as provided in the Contract, or by the exercise of any other remedy provided for by Contract Documents or by law.

1.20 BLASTING AND EXPLOSIVES

- A. Blasting shall not be allowed.

1.21 WEATHER CONDITIONS

- A. No work shall be done when the weather is unsuitable. The CONTRACTOR shall take necessary precautions (in the event of impending storms) to protect all work, materials, or equipment from damage or deterioration due to floods, driving rain, or wind. The OWNER reserves the right, through the opinion of the ENGINEER, to order that additional protection measures over and beyond those proposed by the CONTRACTOR, be taken to safeguard all components of the Project. The CONTRACTOR shall not claim any compensation for such precautionary measures so ordered, nor claim any compensation from the OWNER for damage to the work from weather elements.
- B. The mixing and placing of concrete or pavement courses, the laying of masonry, and installation of sewers and water mains shall be stopped during rainstorms, if ordered by the ENGINEER; and all freshly placed work shall be protected by canvas or other suitable covering in such manner as to prevent running water from coming in contact with it. Sufficient coverings shall be provided and kept ready at hand for this purpose. The limitations and requirements for mixing and placing concrete or laying of masonry, in cold weather shall be as described elsewhere in these Specifications.

1.22 PERIODIC CLEANUP: BASIC SITE RESTORATION

- A. Disposal of Debris: All debris, materials, piping, and miscellaneous waste products from the work described in this section shall be removed from the project as soon as possible and not less than twice per week. They shall be disposed of in accordance with applicable federal, state, and local regulations. The CONTRACTOR is responsible for determining these regulations and shall bear all costs or retain any profit associated with disposal of these items.
- B. When the work involves installation of sewers, drains, water mains, manholes, underground structures, or other disturbance of existing features in or across streets, rights-of-way, easements, or private property, the CONTRACTOR shall (as the work progresses) promptly backfill, compact, grade, and otherwise restore the disturbed area to the basic condition which will permit resumption of pedestrian or vehicular traffic and any other critical activity or functions consistent with the original use of the land. The requirements for temporary paving of streets, walks, and driveways are specified elsewhere. Unsightly mounds of earth, large stones, boulders, and debris shall be removed so that the site presents a neat appearance.
- C. The CONTRACTOR shall perform the cleanup work on a regular basis and as frequently as ordered by the ENGINEER. Basic site restoration in a particular area shall be accomplished immediately following the installation or completion of the required facilities in that area. Furthermore, such work shall also be accomplished, when ordered by the ENGINEER, if partially completed facilities must remain incomplete for some time period due to unforeseen circumstances.

- D. Upon failure of the CONTRACTOR to perform periodic cleanup and basic restoration of the site to the ENGINEER's satisfaction, the OWNER may, upon five (5) days prior written notice to the CONTRACTOR, without prejudice to any other rights or remedies of the OWNER, cause such work for which the CONTRACTOR is responsible to be accomplished to the extent deemed necessary by the ENGINEER, and all costs resulting therefrom shall be charged to the CONTRACTOR and deducted from the amounts of money that may be due him.
- D. Refer to Section 01640 entitled "Construction and Demolition Waste Management" for additional requirements.

1.23 USE OF FACILITIES BEFORE COMPLETION

- A. The OWNER reserves the right to enter and use any portion of the constructed facilities before final completion of the whole work to be done under this Contract. However, only those portions of the facilities which have been completed to the ENGINEER's satisfaction, as evidenced by his issuing a Certificate of Substantial Completion covering that part of the work, shall be placed in service.
- B. It shall be the OWNER's responsibility to prevent premature connections to or use of any portion of the installed facilities by private or public parties, persons or groups of persons, before the ENGINEER issues his Certificate of Substantial Completion covering that portion of the work to be placed in service.
- C. Consistent with the approved progress schedule, the CONTRACTOR shall cooperate with the OWNER, his agents, and the ENGINEER to accelerate completion of those facilities, or portions thereof, which have been designated for early use by the OWNER.

1.24 SEQUENCE OF CONSTRUCTION

- A. The CONTRACTOR shall plan the work based on the following suggested general work plan and scheduling constraints.
- B. This suggested schedule is based on the OWNER issuing two notice to proceed.
- C. Notice to Proceed No. 1
 - 1. The first notice to proceed date will be agreed to between the OWNER and the CONTRACTOR after contract execution.
 - 2. During the period between Notice to Proceed No. 1 and No. 2, the CONTRACTOR shall perform preliminary work as described in Work Element 1.
- D. Notice to Proceed No. 2
 - 1. The second notice to proceed date will be agreed to between the OWNER and the CONTRACTOR as the CONTRACTOR progresses with its preliminary work.

2. For planning purposes, the CONTRACTOR may assume 120 calendar days between Notice to Proceed No. 1 and No. 2. The actual timeframe will be agreed to between the OWNER and the CONTRACTOR.
3. Certain permits have been obtained by the Engineer. All other necessary permits are the responsibility of the CONTRACTOR. Receipt of all permits required to be obtained by the CONTRACTOR is a condition precedent to the issuance of Notice to Proceed No. 2.
4. The Contractor shall mobilize to the project site with 30 calendar days of the Notice to Proceed No. 2 date.

E. Work Element 1: Preliminary Work

1. Scheduling Constraint: Work element 1 shall be initiated as soon as possible after the CONTRACTOR receives Notice to Proceed No. 1.
2. During Work Element 1, the CONTRACTOR shall perform preliminary work including the following:
 - a) Prepare and submit a project schedule
 - b) Prepare and submit a schedule of values
 - c) Prepare and submit a shop drawing log
 - d) Prepare and submit long lead item shop drawings
 - e) Prepare and submit other documents required for permitting
 - f) Call sunshine and designate existing underground utilities in vicinity of work area
 - g) Prepare and submit video log of pre-construction conditions of the project area
 - h) Conduct site visit with the ENGINEER to review the project site and development water disposal plan.
 - i) Perform work that does not require CONTRACTOR obtained permits.

F. Work Element 2: Mobilize to Project Site

1. Scheduling Constraint: The CONTRACTOR shall mobilize to the project site with 30 calendar days of the Notice to Proceed No. 2 date.
2. The CONTRACTOR shall establish maintenance of traffic detours and signages per the terms of its permit.
3. Setup temporary construction barriers as indicated on the plans.
4. Construct any necessary tree protection barriers.

5. Mobilizing drill rig to site and setup for drilling.
6. Notify the ENGINEER of the estimated date that drilling will begin.

G. Work Element 3: Existing Underground Utilities

1. Scheduling Constraint: Work Element 4 shall begin as soon as possible after receipt of Notice to Proceed No. 2.
2. Perform exploratory excavations to confirm the location, elevation and alignment of existing underground utilities that may interfere with the proposed improvements.
3. Coordinate with the owners of the existing underground utilities in the vicinity of the proposed wellhead structure. Determine if there is a conflict between the existing underground utilities and the proposed structure.
4. The Contractor shall either relocate conflicting utilities in manner that is acceptable to the owners of the utilities or pay the utilities owners to relocate the conflicting utilities. Payment for relocating conflicting utilities shall be through the allowance bid item titled "Utility Relocation Allowance".

H. Work Element 4: Drilling

1. Scheduling Constraint: Work Element 4 can start as soon as Work Element 2 is completed. Install temporary piping for disposal of development water to the discharge location shown on the Drawings in a timely manner to ensure it is available when needed for water disposal.
2. Drill nominal 8-inch diameter pilot hole to approximately 80 feet below land surface (BLS), or to depth as identified by the Engineer, using the mud-rotary method.
3. Clean and condition the 8-inch diameter pilot hole.
4. Perform geophysical logging caliper and gamma ray logging of the 8-inch diameter pilot hole.
5. Ream nominal 32-inch diameter borehole to approximately 80 feet BLS, or to depth as identified by the Engineer.
6. Clean and condition the 32-inch diameter borehole.
7. Perform caliper logging of the 32-inch diameter borehole.
8. Install 24-inch diameter Schedule 80 PVC casing to approximately 80 feet BLS, or to depth as identified by the Engineer, and cement in place.
9. Displace drilling mud and drill out cement plug using clear water circulation.

10. The Contractor shall ensure that adequate potable water is introduced into the well until sufficient formation circulation has been established to avoid exceeding the hydraulic collapse pressure of the casing.
11. Drill nominal 24-inch open-hole to approximately 100 feet BLS, or to depth as identified by the Engineer, using the reverse air method.
12. Develop open-hole by reverse-air open circulation for approximately eight hours, or as identified by the Engineer.
13. Once clear water is obtained, collect water samples and test for the parameters below. Just before completing the air development phase, collect water samples and test for the parameters below.
 - a) Total dissolved solids (TDS)
 - b) Temperature (Field Measured by the Contractor)
 - c) Conductivity (Field Measured by the Contractor)
 - d) Chlorides
14. Perform geophysical logging of the open-hole. Logging shall include:
 - a) Caliper
 - b) Gamma ray
 - c) Dual-Induction
 - d) Static and Dynamic Conductivity
 - e) Static and Dynamic Temperature
 - f) Static and Dynamic Flow Meter
15. Develop well by high rate pumping and surging until the criteria defined in the Specification Section titled "WELL DEVELOPMENT" are achieved, or as identified by the Engineer.
16. Conduct step-drawdown pumping test.
17. During the step-drawdown pumping test, collect hydraulic and water quality data as indicated in the Specification titled "Pumping Tests".
18. Complete the alignment test.

I. Work Element 5: Wellhead Construction

1. Scheduling Constraint: Work Element 5 can start as soon as Work Element 4 is completed.
2. Start and complete wellhead construction as indicated on the Drawings and Specifications.
3. All permanent equipment and materials to be installed in the well shall be chlorinated just prior to installation in accordance with the Specification titled "Wellhead Disinfection".

4. Design, furnish and install temporary piping to convey water from the pump to the discharge location indicated on the Drawing titled "Development Water Disposal Plan". The temporary pipe shall include a valve that can create enough headloss to achieve 90 psi discharge pressure as measured by the proposed wellhead pressure gauge upstream of the proposed check valve.
5. The design of the temporary piping shall include design of all necessary temporary modifications, such as excavations and road plates as necessary to ensure that the piping does not block access to business entrances along the route from the proposed well to the water discharge location.
6. Complete startup and testing of the proposed pumping system and associated electrical equipment and controls. The ENGINEER will periodically observe field testing.
7. Submit testing reports to the ENGINEER. Submit completed "Manufacturer's Certificate of Proper Installation" for all major equipment items (including mechanical, electrical and controls).
8. After acceptance of the test results by the ENGINEER, disinfect the well in accordance with the Specification titled "Wellhead Disinfection" and disinfect and test wellhead piping in accordance with the Specification titled "Pipeline Testing and Disinfection". Submit test results to the ENGINEER.
9. If the raw water pipeline from the proposed well PW-9 to the existing well PW-8 (constructed under a separate contract) has been completed, provide labor and materials as needed to complete the final connection of well PW-9 to the transmission system piping.
10. Complete surface restoration and closeout.
11. Note that water from well PW-9 cannot be conveyed to the water treatment plant until the Engineer-of-Record for the Production Well PW-9 project and the Engineer-of-Record for the Raw Water Pipeline project obtain permission from the Florida Department of Environmental Protection.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not Used)

- END OF SECTION -

SECTION 01011 - SPECIAL INSPECTIONS

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall provide a Special Building Inspector, in accordance with the requirements of the Florida Building Code (latest edition), to perform all special inspections required by the Building Department with jurisdiction.
- B. The Special Inspector shall be a Professional Engineer licensed in the State of Florida.
- C. It is recognized that the scope of services associated with providing the special inspector services cannot be quantified until the Contractor applies for a Building Permit with the City of Hallandale Building Department and the Building Department defines the scope of special inspections. For the purposes of establishing a scope for the inspections, the Contractor shall assume an allowance amount as indicated on the Bid Form to pay for professional engineering services.
- F. The allowance amount is an estimate and is a cost pass through item and no mark-ups will be added to this item. The Contractor shall produce documentation upon request verifying actual cost. Any portion of the allowance that remains after all authorized payments have been made will be withheld from contract payments and will remain with the OWNER.

1.02 SPECIAL BUILDING INSPECTOR FORM

- A. Contractor shall prepare and submit the Form for "Special Building Inspection" as required by the Building Department with jurisdiction. The form shall be executed by the Professional Engineer licensed in the state of Florida.
- B. Provide a copy of the form that is submitted to the Building Department to the Engineer and the OWNER for informational purposes.

1.03 INSPECTION REPORTS

- A. Prepare a log of all progress reports and inspections related to the Special Inspections required by the Building Official. The log shall be maintained at the job site.
- B. On a weekly basis submit signed and sealed progress reports and inspection reports to the Building Official as per Section 110.10.6.2 of the Broward County Amendments to the Florida Building Code.
- C. Provide copies of the reports that are submitted to the Building Department to the Engineer and the OWNER for informational purposes.

1.04 CERTIFICATION

- A. The Special Inspector shall submit a Certificate of Compliance prior to scheduling the final building inspection in accordance with the Florida Building Code.
- B. The Certificate of Compliance shall state that the work performed by the Contractor was done, substantially in accordance with the applicable portion of the permitted construction documents as delineated in the special building inspection plan.
- C. Furnish a copy of the Certificate of Compliance to the OWNER and the Engineer.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not Used)

- END OF SECTION -

SECTION 01015 – PLASTIC WATER FILLED BARRIERS

PART 1 - GENERAL

1.01 THE REQUIREMENTS

- A. Plastic water filled barriers shall be high impact, UV resistant and constructed of polyethylene.
- B. All plastic water filled barriers for traffic and safety control shall be suitable for traffic channeling and control, lane delineation, crowd control, identification of parking areas and other similar approved uses.
- C. The barricade units provided under this Section shall be the only type of barriers permitted for use by the CONTRACTOR for the separation of work zone(s), pedestrian traffic, and other areas requiring partitioning and/or separation on the Project.
- D. Please note that the use of standard barriers, chain link fencing, temporary plywood walls / handrails, and other similar types of installations shall not be considered acceptable.

PART 2 - PRODUCTS

2.01 BARRIERS

- A. Furnish and install plastic water filled Jersey barriers were indicated on the Drawings and as required by the Contractor's maintenance of traffic plan.
- B. Colors: All barriers shall be safety orange.
- C. Barriers shall be equipped with flashing lights.

PART 3 – EXECUTION

3.01 CONTRACTOR'S USE OF BARRIERS

- A. Barriers shall be furnished where shown on drawings.
- B. Barriers shall also be used where other situations arise that require the installation of a temporary barrier between the public and the Work area.
- C. The CONTRACTOR shall make all arrangements and provide all requisite labor for the delivery, loading, unloading, filling with water, deployment and redeployment of barriers as required to meet the intent of the Project.
- D. The CONTRACTOR shall verify that all barriers, when deployed, are interlocked and filled with water in accordance with manufacturer's recommendation.

- E. Draining, repositioning / interlocking, filling and refilling barriers shall be the responsibility of the CONTRACTOR for the duration of the Project. In this capacity, barriers will be refilled / cleaned, when deemed necessary to maintain aesthetic appearance or intended performance. If necessary, the CONTRACTOR shall utilize an anti-fungal inhibitor when filling barriers.
- F. The source of water for filling of barriers shall be subject to OWNER approval. The CONTRACTOR shall be responsible for all equipment costs, and labor required for filling / refilling / draining of barriers.
- G. Remove barriers from the project site at a date and time agreed upon with the OWNER.

- END OF SECTION -

SECTION 01025 - MEASUREMENT AND PAYMENT

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Payment for the various items in the Schedule of Payment items, as further specified herein, shall include all compensation to be received by the CONTRACTOR for furnishing all tools, equipment, supplies, and manufactured articles, and for all labor, operations, taxes, materials, commissions, transportation and handling, bonds, permit fees, insurance, overhead and profit, and incidentals appurtenant to the items of Work being described, as necessary to complete the various items of the Work, all in accordance with the requirements of the Contract Documents, including all appurtenances thereto, and including all costs of compliance with the regulations of public agencies having jurisdiction, including Safety and Health Requirements of the Occupational Safety and Health Administration of the U.S. Department of Labor (OSHA). Such compensation shall also include payment for any loss or damages arising directly or indirectly from the Work.
- B. The CONTRACTOR's attention is called to the fact that the quotations for the various items of Work are intended to establish a total price for completing the Work in its entirety. Should the CONTRACTOR feel that the cost for any item of Work has not been established by the Schedule of Payment items or this Section, it shall include the cost for that Work in some other applicable bid item, so that its proposal for the project does reflect its total price for completing the Work in its entirety.

1.02 SUBMITTALS

- A. Informational:
 - 1. Schedule of Values: Submit schedule on OWNER's form.
 - 2. Application for Payment.
 - 3. Final Application for Payment.
- B. Submittals shall be in accordance with Section 01300 entitled "Submittals" and the OWNER's standards.

1.03 SCHEDULE OF VALUES

- A. Prepare a schedule of values for the Work.
- B. Unit Price Work: Reflect unit price quantity and price breakdown from conformed Bid Form.
- C. Lump Sum Work:

1. Reflect schedule of values format included in conformed Bid Form.
 2. List Bonds and insurance premiums, mobilization, demobilization, facility startup, and contract closeout separately.
 3. Break down by Divisions 1 through 17 with appropriate subdivision of each Specification.
- D. An unbalanced or front-end loaded schedule will not be acceptable.
- E. Summation of the complete schedule of values representing all the Work shall equal the Contract Price.
- F. The CONTRACTOR shall submit a Schedule of Values for review with the return of the executed Agreement to the OWNER. The schedule shall contain the installed value of the component parts of Work for the purpose of making progress payments during the construction period.
- G. The schedule shall be given in sufficient detail for proper identification of Work accomplished. The Schedule of Values shall directly correlate to each activity outlined in the construction progress schedule and the construction network analysis (specified in the section entitled "Submittals") to accurately relate construction progress to the requested payment. Each item shall include its proportional share of all costs including the CONTRACTOR's overhead, contingencies and profit. The sum of all scheduled items shall equal the total value of the Contract.
- H. If the CONTRACTOR anticipates the need for payment for materials stored on the project site or off-site in bonded warehouse, it shall also submit a separate list covering the cost of materials, delivered and unloaded with taxes paid. This list shall also include the installed value of the item with coded reference to the Work items in the Schedule of Values. Payment for stored materials shall comply with requirements of General Conditions.

1.04 APPLICATION FOR PAYMENT

- A. Transmittal Summary Form: Attach one Summary Form with each detailed Application for Payment and include Request for Payment of Materials and Equipment on Hand as applicable. Execute certification by authorized officer of CONTRACTOR.
- B. Use detailed Application for Payment Form provided by OWNER.
- C. Include accepted schedule of values for each portion of Work and the unit price breakdown for the Work to be paid on unit price basis, and a listing of OWNER-selected equipment, if applicable, and allowances, as appropriate.

D. Preparation:

1. Round values to nearest dollar.
2. List each Change Order and Written Amendment executed prior to date of submission as separate line item. Totals to equal those shown on the Transmittal Summary Form.
3. Submit Application for Payment, including a Transmittal Summary Form and detailed Application for Payment Form, a listing of materials on hand as applicable, and such supporting data as may be requested by OWNER.

1.05 MEASUREMENT—GENERAL

- A. Weighing, measuring, and metering devices used to measure quantity of materials for Work shall be suitable for purpose intended and conform to tolerances and Specifications as specified in National Institute of Standards and Technology, Handbook 44.
- B. Whenever pay quantities of material are determined by weight, material shall be weighed on scales furnished by CONTRACTOR and certified accurate by state agency responsible. Weight or load slip shall be obtained from weigher and delivered to OWNER or OWNER's representative at point of delivery of material.
- C. If material is shipped by rail, car weights will be accepted provided that actual weight of material only will be paid for and not minimum car weight used for assessing freight tariff, and provided further that car weights will not be acceptable for material to be passed through mixing plants.
- D. Vehicles used to haul material being paid for by weight shall be weighed empty daily and at such additional times as required by OWNER. Each vehicle shall bear a plainly legible identification mark.
- E. Materials that are specified for measurement by the cubic yard measured in the vehicle shall be hauled in vehicles of such type and size that actual contents may be readily and accurately determined. Unless all vehicles are of uniform capacity, each vehicle must bear a plainly legible identification mark indicating its water level capacity. Vehicles shall be loaded to at least their water level capacity. Loads hauled in vehicles not meeting above requirements or loads of a quantity less than the capacity of the vehicle, measured after being leveled off as above provided, will be subject to rejection, and no compensation will be allowed for such material.
- F. Where measurement of quantities depends on elevation of existing ground, elevations obtained during construction will be compared with those shown on Drawings. Variations of 1 foot or less will be ignored, and profiles shown on Drawings will be used for determining quantities.
- G. Units of measure shown on Bid Form shall be as follows, unless specified otherwise. All methods of measurement shall be approved by the OWNER.

Item	Method of Measurement
AC	Acre—Field Measure
CY	Cubic Yard—Field Measure within limits specified or shown, or measured in vehicle by volume, as specified
EA	Each—Field Count
GAL	Gallon—Field Measure
HR	Hour
LB	Pound(s)—Weight Measure by Scale
LF	Linear Foot—Field Measure
LS	Lump Sum—Unit is one; no measurement will be made
SF	Square Foot
SY	Square Yard
TON	Ton—Weight Measure by Scale (2,000 pounds)

1.06 PAYMENT

A. General:

1. Progress payments will be made monthly.
2. The date for CONTRACTOR's submission of monthly Application for Payment shall be established at the Preconstruction Conference.

- B. Payment for Lump Sum Work covers all Work specified or shown including but not limited to all material, labor, and equipment for all structural, architectural, mechanical, electrical, fire alarm system, instrumentation, controls, plumbing, ventilation, air conditioning, earthwork, civil work, irrigation, landscaping, painting, roadway paving and signage, operation and maintenance manuals, facility staff training, spare parts, startup and testing, final site work, together with all other appurtenant and miscellaneous work required for a complete installation as indicated in the Contract Documents. Payments for lump sum work will be made at the contract lump sum price(s) entered on the Proposal. All items of work not included but required to complete the work shall be included in the lump sum bid amount. Payment for Lump Sum Work covers all Work specified or shown for the following items:

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ITEM	DESCRIPTION										
1. Mobilization and demobilization (Shall not exceed 10% of the total base bid price)	<p>Payment for mobilization and demobilization will be made at the lump sum price named in the Bid Schedule. Mobilization includes, but is not limited to, maintenance of traffic, videos, computer, construction trailers (complete), site cleanup, sanitary facilities, labor associated with permit acquisition, contractors staging area, project signs, testing, project coordination, and demobilization. Partial payments for mobilization will be made as follows:</p> <table> <tr> <th>Construction % Complete</th><th>Allowable % of Lump Sum for Mobilization</th></tr> <tr> <td>5</td><td>25</td></tr> <tr> <td>10</td><td>50</td></tr> <tr> <td>25</td><td>75</td></tr> <tr> <td>100</td><td>100</td></tr> </table>	Construction % Complete	Allowable % of Lump Sum for Mobilization	5	25	10	50	25	75	100	100
Construction % Complete	Allowable % of Lump Sum for Mobilization										
5	25										
10	50										
25	75										
100	100										
2. Performance and Payment Guaranty and Insurance (Shall not exceed 5% of the total base bid price)	<p>Included in this item are all performance and payment guaranties associated with this contract. This item shall also include the cost of required insurance for the work as specified in the Contract Documents. The payment for this item shall not exceed three percent of the Total Bid Price. Payment for 100 percent of this item, less standard retainage, may be made upon execution of the Contract and the submittal of the first payment request.</p> <p>Performance and Payment Guaranty and Insurance <u>1</u> LS</p>										
3. Consideration for Indemnification	<p>Payment for consideration for indemnification of the OWNER will be based upon the lump sum price named for such work, in accordance with the requirements of the Contract Documents.</p> <p>Payment will be twenty-five dollars for consideration for indemnification named in the bid schedule and shall constitute full compensation for indemnifying the OWNER as specified in the Contract Documents.</p> <p>Indemnification <u>1</u> LS</p>										
4. Permit Fees Allowance	<p>Payment for permit fees will be based upon the actual permit fees required by the CONTRACTOR from the various agencies having jurisdiction for construction of the project, in accordance with the Contract Documents. The allowance amount shown on the bid schedule is an estimate of permit fees required for the project and is a cost pass through item and no mark-ups will be added to this item. The CONTRACTOR shall produce documentation upon request verifying actual cost. Only permit fees substantiated by the CONTRACTOR and approved by the ENGINEER will be paid as part of this bid item.</p> <p>Permit Fees Allowance <u>1</u> Allowance</p>										

ITEM	DESCRIPTION
5. Utility Relocation Allowance	<p>Included in this allowance is all work associated with relocation of utilities that conflict with the proposed improvements. All work authorized for payment will be authorized in writing by the OWNER. Amount to be paid shall be negotiated or agreed to by both parties. The OWNER reserves the right to award any, all or none of the money associated with this allowance.</p> <p>Utility Relocation Allowance <u> 1 </u> Allowance</p>
6. Special Inspector Allowance	<p>Included in this allowance is all material, labor, and equipment for all work necessary and required for a licensed Professional Engineer to perform special inspections of the Work. This item includes, but is not limited to, performing all special inspections required by the Florida Building Code and all discretionary special inspections as required by the City of Hallandale Beach Building Department, completion of all inspection reports, and completion/submittal of the Certification of Compliance. The allowance amount shown on the bid schedule is an estimate of services required. Payment will be based on the actual fee paid directly to the Special Inspector, documented by paid receipts, specifically excluding any labor, mark-up, overhead and profit, administration or other costs involved in obtaining licenses or paying fees. Any portion of this allowance that remains after all authorized payments have been made will be withheld from contract payments and will remain with the Owner.</p> <p>Special Inspector Allowance <u> 1 </u> Allowance</p>
7. All Other Work	<p>Included in the item is all material, labor, and equipment for all structural, architectural, mechanical, electrical, instrumentation, controls, earthwork, civil work, irrigation, landscaping, painting, roadway paving and signage, operation and maintenance manuals, facility staff training, spare parts, startup and testing, final site work, together with all other appurtenant and miscellaneous work required for a complete installation as indicated in the Contract Documents. This item also includes compliance with all general conditions, specific conditions, permit conditions, Division 1 requirements, and all other requirements not included in other bid items for a complete installation as indicated in the Contract Documents. Payments for lump sum work will be made at the contract lump sum price entered on the Bid Proposal Form. All items of work not included but required to complete the work shall be included in the lump sum bid amount.</p> <p>All Other Work <u> 1 </u> LS</p>

1.07 NONPAYMENT FOR REJECTED OR UNUSED PRODUCTS

A. Payment will not be made for following:

1. Loading, hauling, and disposing of rejected material.
2. Quantities of material wasted or disposed of in manner not called for under Contract Documents.
3. Rejected loads of material, including material rejected after it has been placed by reason of failure of CONTRACTOR to conform to provisions of Contract Documents.
4. Material not unloaded from transporting vehicle.
5. Defective Work not accepted by OWNER.
6. Material remaining on hand after completion of Work.

1.08 PARTIAL PAYMENT FOR STORED MATERIALS AND EQUIPMENT

- A. Partial Payment: No partial payments will be made for materials and equipment delivered or stored unless Shop Drawings or preliminary operation and maintenance manuals are acceptable to ENGINEER.
- B. Final Payment: Will be made only for products incorporated in Work; remaining products, for which partial payments have been made, shall revert to CONTRACTOR unless otherwise agreed, and partial payments made for those items will be deducted from final payment.

1.09 ALLOWANCES

- A. The allowances shall be used only at the discretion of and as ordered by the OWNER for such items as unforeseen conditions, unforeseeable conflicts between existing elements of work and the proposed work, unit price items exceed estimated quantities, and any associated work requested by the OWNER including all labor, materials, and services for modifications or extra work to complete the Project that was anticipated, but not specifically included in this Contract.
- B. Any portion of these allowances that remain after all authorized payments have been made will be withheld from contract payments and will remain with the OWNER.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

- END OF SECTION -

SECTION 01030

HURRICANE PREPAREDNESS

PART 1 -- GENERAL

1.01 HURRICANE PREPAREDNESS PLAN

- A. The Contractor's attention is drawn to the possibility of hurricane or severe storm conditions occurring at the site of work during the course of Contract Work.
- B. Within fourteen (14) days of the date of the Notice to Proceed, the Contractor shall submit to the Engineer and Owner a Hurricane Preparedness Plan. The plan should outline the necessary measures which the Contractor proposes to perform at no additional cost to the Owner in case of a hurricane or severe weather warning.
- C. In the event of inclement weather, or whenever the Owner shall direct, the Contractor shall, and will, cause Subcontractors to protect carefully the Work and materials against damage or injury by reasons of failure on the part of the Contractor or any Subcontractor to so protect the Work. Such Work and materials so damaged shall be removed and replaced at the expense of the Contractor.
 - 1. Hurricane Watch: Upon designation of a hurricane watch, the Contractor shall be responsible for storing all loose supplies and equipment on the job site that may pose a danger. In addition, the Contractor shall remove all bulkheads and plugs in pipelines that would impede drainage in the case of flooding. Structures that may be in danger of floatation shall be flooded. The Contractor shall also cooperate with the Owner in protecting any other structures at the site.
 - 2. Hurricane Warning: No mobile "temporary facility" under the control of or on the property of the Owner shall be staffed during a hurricane warning. Contractor facilities meeting these criteria shall be evacuated. Reasonable steps shall be taken to protect all such facilities and their contents from damage and to avoid the facility causing damage to the surroundings.
- D. The Contractor may be required to backfill excavation depending on the severity of the approaching storm or the expected amount of rainfall. Additionally, erosion protection and inlet protection may also be required by the Owner depending on the site conditions at the time of the Hurricane Watch.

PART 2 -- PRODUCTS - (Not Used)

PART 3 -- EXECUTION - (Not Used)

- END OF SECTION -

SECTION 01040 - COORDINATION

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall allow the OWNER or their agents, and other project CONTRACTOR's or their agents, to enter upon the work for the purpose of constructing, operating, maintaining, removing, repairing, altering, or replacing such pipes, sewers, conduits, manholes, wires, poles, or other structures and appliances which may be required to be installed at or in the work. The CONTRACTOR shall cooperate with all aforesaid parties and shall allow reasonable provisions for the prosecution of any other work by the OWNER, or others, to be done in connection with his work, or in connection with normal use of the facilities.
- B. Each CONTRACTOR shall cooperate fully with the OWNER, the ENGINEER, and all other CONTRACTOR's employed on the work, to effect proper coordination and progress to complete the project on schedule and in proper sequence. Insofar as possible, decisions of all kinds required from the ENGINEER shall be anticipated by the CONTRACTOR to provide ample time for inspection, or the preparation of instructions.
- C. Each CONTRACTOR shall assume full responsibility for the correlation of all parts of his work with that of other CONTRACTOR's. Each CONTRACTOR's superintendent shall correlate all work with other CONTRACTOR's in the laying out of work. Each CONTRACTOR shall lay out his own work in accordance with the Drawings, Specifications, and instructions of latest issue and with due regard to the work of other CONTRACTOR's.
- D. Periodic coordinating conferences shall be held in accordance with Section 01200, Project Meetings, of these Contract Documents.

1.02 SUBMITTALS

- A. Informational:
 - 1. Statement of Qualification (SOQ) for land surveyor or civil engineer.
 - 2. Statement of Qualification (SOQ) for professional videographer.
 - 3. Construction Photos: Submit digital photos within five days of being taken.
 - 4. Audio-Video Recordings: Submit digital audio-video recording within five days of being taken.

1.03 UTILITY NOTIFICATION AND COORDINATION

- A. Coordinate the Work with various utilities within Project limits. Notify applicable utilities prior to commencing Work.
1. Contact the City of Hallandale Beach Public Works Department at 954-457-1623 for water, sanitary sewer and storm sewer utility locations.
 2. Contact Sunshine State One Call at 1-800-432-4770 at least 48 hours prior to any excavation.
- B. If damage occurs, or if conflicts or emergencies arise during Work, contact the appropriate utility.

Company Name	Contact Person	Position	Office Phone	Cell Phone	Email
AT&T	Phil Vecchio	Engineering and Manager	954-423-6305	954-592-7074	pv8321@att.com
TCS Communications	Angel Prieto		813-298-2445		angel.prieto@tcscomm.com
FPL	Nancy Diaz-Quinones	South Broward Service Planning	954-442-6337	754-208-6867	nancy.diaz-quinones@fpl.com
FPL	Lenin Vargas	Hallandale Beach WTP FPL Tech Rep	(954) 442-6362	(305) 987-4926	lenin.vargas@fpl.com
TECO Gas	David Rivera	TECO peoples gas	954-453-0794	407-466-6978	drrivera@tecoenergy.com
TECO Gas Con. R.A.w Cons	Julio Companioni	Teco Contractor	305-957-0935	786-543-9291	juliocompanioni820@gmail.com
FDOT - District 4	Roger Lemieux	Permit Coordinator	954-777-4372		roger.lemieux@dot.state.fl.us
Comcast	Chuck Huston	Comcast Construction Coordinator	954-447-8408	954-410-2054	charles_huston@cable.comcast.com
Pike Electric FPL's Contractor	Michael Martin	General Foreman			MBMartin@pike.com
Pike Electric FPL's Contractor	Michael Simmons	Pike Superintendent			MSimmons2@pike.com
Mastec AT&T Contractor	Rene Rojas	supervisor	954-587-4774	786-566-8157	Rene.Rojas@mastec.com
Master Construction	Silvio Martinez			786-295-3163	martinez.silvio@rocketmail.com

1.04 COORDINATION FOR UTILITIES TO BE RELOCATED

- A. There are existing underground utilities in the vicinity of the proposed Production Well PW-9 that may conflict with the construction of the proposed well structure. Perform exploratory excavations where indicated on the Drawings to expose these utilities as soon as practicable after the notice to proceed. Coordinate with the utility owners to relocate the conflicting utilities.
- B. Notify the ENGINEER in writing of existing utilities that conflict with the proposed well structure.
- C. If permitted by the utility owner, the CONTRACTOR can relocate existing underground utilities that conflict with the proposed production Well PW-9. The CONTRACTOR shall be responsible for designing the relocated utility to the satisfaction of the utility owner. The CONTRACTOR shall be paid for relocation of existing utilities through the bid item titled "Utility Relocation Allowance".

1.05 ADJACENT FACILITIES AND PROPERTIES

- A. Examination:
 - 1. After Effective Date of the Agreement and before Work at site is started, CONTRACTOR, OWNER, and affected property owners and utility owners shall make a thorough examination of pre-existing conditions including existing buildings, structures, and other improvements in vicinity of Work, as applicable, which could be damaged by construction operations.
 - 2. Periodic reexamination shall be jointly performed to include, but not limited to, cracks in structures, settlement, leakage, and similar conditions.
- B. Documentation:
 - 1. Record and submit documentation of observations made on examination inspections in accordance with paragraphs CONSTRUCTION PHOTOGRAPHS and AUDIO-VIDEO RECORDINGS.
 - 2. Upon receipt, ENGINEER will review, sign, and return one record copy of documentation to CONTRACTOR to be kept on file in field office.
 - 3. Such documentation shall be used as indisputable evidence in ascertaining whether and to what extent damage occurred as a result of CONTRACTOR's operations, and is for the protection of adjacent property owners, CONTRACTOR, and OWNER.

1.06 CONSTRUCTION PHOTOGRAPHS

- A. Photographically document all unique portions of the construction including tie-ins to existing pipelines or facilities, crossings of existing utilities, buried valve and piping

intersections, and other work items that will not otherwise be visible after completion of construction.

- B. Photographs shall be digital.
- C. OWNER and ENGINEER shall have the right to select the subject matter and vantage point from which photographs are to be taken.
- D. Construction Progress Photos:
 - 1. Photographically demonstrate progress of construction, showing every aspect of site and adjacent properties as well as interior and exterior of new or impacted structures.
 - 2. Weekly: Take 10 digital photographs.
 - 3. Digital file names shall format shall be as follows:
 - a. "Hallandale PW-9 Photo NN – YYYY-MM-DD.jpg"
 - b. NN = photograph number taken on date "YYYY-MM-DD"
 - c. YYYY = year photo was taken
 - d. MM = month photo was taken
 - e. DD = day of the month that photo was taken
 - 4. Photos shall be transmitted via email to the ENGINEER on a weekly basis.

1.07 AUDIO-VIDEO RECORDINGS

- A. Prior to beginning Work on construction site or of a particular area of the Work, and again within 10 days following date of Substantial Completion, videograph construction site and property adjacent to construction site.
- B. In the case of preconstruction recording, no Work shall begin in the area prior to OWNERS's review and approval of content and quality of video for that area.
- C. Particular emphasis shall be directed to the following:
 - 1. Physical condition of existing vegetation and structures
 - 2. The entirety of the area within the staging area
 - 3. The entirety of the area within 50-feet of the exterior of the staging area
 - 4. Pavements along the route for the temporary piping used to dispose of development water

- D. OWNER and ENGINEER shall have right to select subject matter and vantage point from which videos are to be taken.
- E. Digital audio-video recording shall be by a professional commercial videographer, experienced in shooting construction videos.
- F. Video Format and Quality:
 - 1. Video:
 - a. Produce bright, sharp, and clear images with accurate colors, free of distortion and other forms of picture imperfections.
 - b. Electronically, and accurately display the month, day, year, and time of day of the recording.
 - 2. Audio:
 - a. Audio documentation shall be done clearly, precisely, and at a moderate pace.
 - b. Indicate date, Project name, and a brief description of the location of taping, including:
 - 1) Facility name;
 - 2) Street names or easements;
 - 3) Addresses of private property; and
 - 4) Direction of coverage, including engineering stationing, if applicable.

PART 2 - PRODUCTS
(NOT USED)

PART 3 – EXECUTION
(NOT USED)

- END OF SECTION -

SECTION 01070 - ABBREVIATIONS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Wherever in these specifications references are made to the standards, specifications, or other published data of the various national, regional, or local organizations, such organizations may be referred to by their acronym or abbreviation only. As a guide to the user of these specifications, the following acronyms or abbreviations which may appear in these specifications shall have the meanings indicated herein.

1.02 ABBREVIATIONS AND ACRONYMS

AAMA	Architectural Aluminum Manufacturer's Association
AASHTO	American Association of the State Highway and Transportation Officials
ACI	American Concrete Institute
ACOE	Army Corps of Engineers
ACPA	American Concrete Pipe Association
AFBMA	Anti-Friction Bearing Manufacturer's Association, Inc.
AGMA	American Gear Manufacturer's Association
AHGDA	American Hot Dip Galvanizers Association
AI	The Asphalt Institute
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
AMCA	Air Moving and Conditioning Association
ANSI	American National Standards Institute, Inc.
APA	American Plywood Association
API	American Petroleum Institute
APHA	American Public Health Association
APWA	American Public Works Association
ASA	Acoustical Society of America
ASAE	American Society of Agriculture Engineers
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers

ASLE	American Society of Lubricating Engineers
ASME	American Society of Mechanical Engineers
ASMM	Architectural Sheet Metal Manual
ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials
AWPA	American Wood Preservers Association
AWPI	American Wood Preservers Institute
AWS	American Welding Society
AWWA	American Water Works Association
BCDPEP	Broward County Department of Planning and Environmental Protection (formerly BCDNRP)
BCHD	Broward County Health Department
BHMA	Builders Hardware Manufacturer's Association
CMA	Concrete Masonry Association
CRSI	Concrete Reinforcing Steel Institute
DIPRA	Ductile Iron Pipe Research Association
EIA	Electronic Industries Association
ETL	Electrical Test Laboratories
FBC	Florida Building Code
FDEP	Florida Department of Environmental Protection
FDOT	Florida Department of Transportation
FS	Federal Specifications
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society
IPCEA	Insulated Power Cable Engineers Association
ISA	Instrument Systems and Automation
ISO	International Organization for Standardization
MBMA	Metal Building Manufacturers Association
MMA	Monorail Manufacturers Association
MTI	Marine Testing Institute
NAAM	National Association of Architectural Metal Manufacturers
NACE	National Association of Corrosion Engineers
NBS	National Bureau of Standards

NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Association
NIOSH	National Institute of Occupational Safety and Health
NIST	National Institute of Standards and Testing
NRCA	National Roofing Contractors Association
NSF	National Science Foundation
NTMA	National Tile and Marble Association
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
SMACCNA	Sheet Metal and Air Conditioning Contractors National Association
SSPC	Steel Structures Painting Council
SSPWC	Standard Specifications for Public Works Construction
SFWMD	South Florida Water Management District
UL	Underwriters Laboratories, Inc.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not Used)

- END OF SECTION –

SECTION 01090 - REFERENCE STANDARDS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Titles of Sections and Paragraphs: Captions accompanying specification sections and paragraphs are for convenience of reference only, and do not form a part of the Specifications.
- B. Applicable Publications: Whenever in these Specifications references are made to published specifications, codes, standards, or other requirements, it shall be understood that wherever no date is specified, only the latest specifications, standards, or requirements of the respective issuing agencies which have been published as of the date of the opening of bids, shall apply; except to the extent that said standards or requirements may be in conflict with applicable laws, ordinances, or governing codes. No requirements set forth herein or shown on the Drawings shall be waived because of any provision of, or omission from, said standards or requirements.
- C. Specialists, Assignments: In certain instances, Specification text requires (or implies) that specific work is to be assigned to specialists or expert entities, who must be engaged for the performance of that work. Such assignments shall be recognized as special requirements over which the CONTRACTOR has no choice or option. These requirements shall not be interpreted so as to conflict with the enforcement of building codes and similar regulations governing the Work; also they are not intended to interfere with local union jurisdiction settlements and similar conventions. Such assignments are intended to establish which party or entity involved in a specific unit of work is recognized as "expert" for the indicated construction processes or operations. Nevertheless, the final responsibility for fulfillment of the entire set of contract requirements remains with the CONTRACTOR.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of other requirements of the specifications, all work specified herein shall conform to or exceed the requirements of all applicable codes.
- B. References herein to "Building Code" shall mean the South Florida Building Code (SFBC) Broward Edition. The latest edition of the code as approved and used by the local agency as of the date of the opening of bids, as adopted by the agency having jurisdiction, shall apply to the Work herein, including all addenda, modifications, amendments, or other lawful changes thereto.
- C. In case of conflict between codes, reference standards, Drawings and the other Contract Documents, the most stringent requirements shall govern. All conflicts shall be brought to the attention of the ENGINEER for clarification and directions prior to ordering or providing any materials or labor. The CONTRACTOR shall follow the most stringent requirements.

- D. Applicable Standard Specifications: The CONTRACTOR shall construct the Work specified herein in accordance with the requirements of the Contract Documents and the referenced portions of those referenced codes, standards, and Specifications listed herein.
- E. References herein to "OSHA Regulations for Construction" shall mean Title 29, Part 1926, Construction Safety and Health Regulations, Code of Federal Regulations (OSHA), including all changes and amendments thereto.
- F. References herein to "OSHA Standards" shall mean Title 29, Part 1910, Occupational Safety and Health Standards, Code of Federal Regulations (OSHA), including all changes and amendments thereto.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not used)

-END OF SECTION-

SECTION 01200 - PROJECT MEETINGS

PART 1 -- GENERAL

1.01 PRECONSTRUCTION MEETING

A. General: A preconstruction meeting will be held after Award of Contract, but prior to starting work at the site. The ENGINEER will schedule the meeting at a mutually agreed time.

B. Location:

City of Hallandale Beach Water Treatment Plant
630 NW 2nd St
Hallandale Beach, FL 33009
Contact: Aqeel A. Ghany
Phone: (954) 457-3045

C. Attendance:

1. Owner
2. Engineer
3. Contractor
4. Major subcontractors
5. Safety representative
6. Representatives of governmental or other regulatory agencies.
7. Program Construction Manager (ENGINEER)

D. Minimum Agenda: The purpose of the meeting is to designate responsible personnel and establish a working relationship. The agenda will include the following:

1. Tentative construction schedule
2. Critical work sequencing
3. Designation of responsible personnel
4. Processing of Field Decisions and Change Orders
5. Adequacy of distribution of Contract Documents
6. Submittal of Shop Drawings and samples

7. Procedures for maintaining record documents
 8. Use of site and Owner's requirements
 9. Major equipment deliveries and priorities
 10. Safety and first aid procedures
 11. Security procedures
 12. Housekeeping procedures
 13. Processing of Partial Payment Requests
 14. General regard for community relations
- E. Duties: The ENGINEER will preside at the meeting and will keep and distribute meeting minutes.

1.02 PROGRESS MEETING

- A. Frequency: Progress meetings will be held weekly during the performance of the work of this Contract. Additional meetings may be called as progress of work dictates. Meetings may be held less frequently at the discretion of the ENGINEER.
- B. Meeting Location:
- City of Hallandale Beach Water Treatment Plant
630 NW 2nd St
Hallandale Beach, FL 33009
- C. Attendance:
1. Owner
 2. Engineer
 3. Contractor
 4. Subcontractors active on-site
 5. Others as may be requested by OWNER or ENGINEER
 6. The CONTRACTOR may at its discretion request attendance of its suppliers and manufacturers.

D. Minimum Agenda: The purpose of the meetings will be to review progress of the work and maintain coordination efforts. The agenda will include the following:

1. Review and approve minutes of previous meetings.
2. Review progress of Work since last meeting.
3. Review the proposed 2 week look ahead schedule.
4. Review the longer range 30-60 day construction schedule.
5. Note and identify problems which impede planned progress.
6. Develop corrective measures and procedures to regain planned schedule.
7. Revise construction schedule as indicated and plan progress during next work period.
8. Maintaining of quality and work standards.
9. Complete other current business.
10. Schedule next progress meeting.

E. Duties: The ENGINEER will preside at the meeting and will keep and distribute meeting minutes.

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

SECTION 01300 - SUBMITTALS

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. This section specifies the means of all submittals. All submittals, whether their final destination is to the Owner, Engineer, or other representatives of the Owner, shall be directed through the Engineer. A general summary of the types of submittals and the number of copies required is as follows:

<u>Copies to Engineer</u>	<u>Submittal Format</u>	<u>Type of Submittal</u>
6	Digital	Progress Schedule
6	Digital	Construction Schedule
6	Digital	Schedule of Payment Items
6	Digital	Operations and Maintenance (O&M) Manuals
6	Digital	Progress Estimates
1	Digital	Shop Drawings
2	Digital	Certificates of Compliance
2	Digital	Warranties
2*	As Required	Product Samples
1	Digital	Record Drawings

** Unless otherwise required in the specific Section where requested.*

- B. Paper Submittal Format: Paper submittals shall be hard copy prints of the documents.
- C. Digital Submittal Format: Digital submittals shall be in searchable Adobe PDF format and shall be accessible through the use of standard, "off-the-shelf" software such as Adobe Reader. Hypertext links shall be embedded throughout the text for ease of navigation between references.

1.02 SUBMITTAL PROCEDURES

- A. Transmit each submittal with a form acceptable to the Engineer, clearly identifying the project Contractor, the enclosed material and other pertinent information specified in other parts of this section. Identify variations from Contract Documents and Product or system limitations which may be detrimental to successful performance of the completed Work.
- B. Revise and resubmit submittals as required, identify all changes made since previous submittals. Resubmittals shall be noted as such.
- C. Distribute copies of reviewed submittals to concerned parties. Instruct parties to promptly report any inability to comply with provisions.
- D. Contractor shall submit electronic copy of submittals for Engineer's review via Procore Document Management. Acceptable electronic formats are Adobe PDF. PDFs shall be searchable. Non-searchable PDFs shall be rejected.
- E. Submittal shall be accompanied by letter of transmittal containing date, project title, Contractor's name, number and title of submittal, list of relevant Specification Sections, notification of deviations from Contract Documents, and other material required for Engineer's review

1.03 CONSTRUCTION PROGRESS SCHEDULE

- A. The Contractor shall have the capability of preparing and utilizing the specified construction progress scheduling techniques. A statement of capability shall be submitted in writing to the Engineer with the return of the executed Agreement to the Owner and will verify that either the Contractor's organization has in-house capability qualified to use the technique or that the Contractor employs a consultant who is so qualified. Capability shall be verified by description of the construction projects to which the Contractor or its consultant has successfully applied the scheduling technique and which were controlled throughout the duration of the project by means of systematic use and updating of the construction progress schedule, the network analysis and associated reports. The submittal shall include the name of the individual on the Contractor's staff who will be responsible for the construction progress schedule and associated reports and for providing the required updating information of same. The Contractor shall submit its proposed progress schedule to the Engineer for review and comment within ten days of the Notice to Award.
- B. The computer generated construction progress schedule and associated report shall include the following tabulations: a list of activities in numerical order, a list of activity precedence, schedules sequenced by Early Start Date, Total Float, and Late Start Date. All schedules shall be in color; black and white schedules will **not** be accepted. Each schedule and report shall include the following minimum items.
 - 1. Activity Numbers
 - 2. Estimated Duration
 - 3. Activity Description
 - 4. Early Start Date (Calendar Dated)
 - 5. Early Finish Date (Calendar Dated)
 - 6. Latest Allowable Start Date (Calendar Dated)
 - 7. Latest Allowable Finish Date (Calendar Dated)
 - 8. Status (whether critical)
 - 9. Estimated Cost of the Activity
 - 10. Total Float and Free Float
- C. In addition, each construction progress schedule, network analysis and report shall be prefaced with the following summary data:
 - 1. Contract Name and Number
 - 2. Contractor's Name
 - 3. Contract Duration and Float
 - 4. Contract Schedule
 - 5. The Effective or Starting Date of The Schedule (the date indicated in the Notice-to-Proceed)
- D. The work day to calendar date correlation shall be based on an 8-hour day and 40-hour week with adequate allowance for holidays, adverse weather and all other special requirements of the Work. Normal work hours are Monday through Friday, 8:00 am to

5:00 pm. Exceptions for construction sequencing requirements shall be as noted in the Section entitled "Summary of Work".

- E. If the Contractor desires to make changes in its method of operating which affect the construction progress schedule and related items, it shall notify the Engineer in writing stating what changes are proposed and the reason for the change. If the Engineer accepts these changes, in writing, the Contractor shall revise and submit, without additional cost to the Owner, all of the affected portions of the construction progress schedule, and associated reports. The construction progress schedule and related items shall be adjusted by the Contractor only after prior acceptance, in writing by the Engineer. Adjustments may consist of changing portions of the activity sequence, activity durations, division of activities, or other adjustments as may be required. The addition of extraneous, nonworking activities and activities which add restraints to the construction progress schedule shall not be accepted.
- F. Except where earlier completions are specified, schedule dates which show completion of all Work prior to the contract completion date shall, in no event, be the basis for claim for delay against the Owner by the Contractor.
- G. Construction progress schedules and related items which contain activities showing negative float or which extend beyond the contract completion date will be accepted only upon the condition that the Contractor will comply with recovery schedule requirements as specified in paragraph H. below.
- H. Whenever it becomes apparent from the current construction progress schedule and associated reports that delays to the critical path have resulted and the contract completion date will not be met, or when so directed by the Engineer, the Contractor shall take some or all of the following actions at no additional cost to the Owner. They shall submit to the Engineer for approval, a written statement of the steps they intend to take to remove or arrest the delay to the critical path in the current construction progress schedule.
 - 1. Increase construction manpower in such quantities and crafts as will substantially eliminate the backlog of work.
 - 2. Increase the number of working hours per shift, shifts per day, working days per week, the amount of construction equipment, or any combination of the foregoing, sufficiently to substantially eliminate the backlog of work.
 - 3. Reschedule activities to achieve maximum practical concurrence of accomplishment of activities, and comply with the revised schedule.
- I. If when so requested by the Engineer, the Contractor should fail to submit a written statement of the steps they intend to take or should fail to take such steps as reviewed and accepted in writing by the Engineer, the Engineer may direct the Contractor to increase the level of effort in manpower (trades), equipment and work schedule (overtime, weekend and holiday work, etc.) to be employed by the Contractor in order to remove or arrest the delay to the critical path in the current construction progress schedule, and the Contractor shall promptly provide such level of effort at no additional cost to the Owner.
- J. If the completion of any activity, whether or not critical, falls more than 100 percent behind its previously scheduled and accepted duration, the Contractor shall submit for approval a schedule adjustment showing each such activity divided into two activities reflecting completed versus uncompleted work.

- K. Shop drawings which are not approved on the first submittal or within the time scheduled, and equipment which does not pass the specified tests and certifications shall be immediately rescheduled.
- L. The contract time will be adjusted only in accordance with the General Requirements and other portions of the Contract Documents as may be applicable. If the Engineer finds that the Contractor is entitled to any extension of the contract completion date, the Engineer's determination as to the total number of days extension shall be based upon the current construction progress schedule and on all data relevant to the extension. Such data shall be included in the next updating of the schedule and related items. Actual delays in activities which, according to the construction progress schedule, do not affect any contract completion date will not be the basis for a change therein.
- M. From time to time it may be necessary for the contract schedule of completion time to be adjusted by the Owner in accordance with the General Requirements and other portions of the Contract Documents as may be applicable. Under such conditions, the Engineer will direct the Contractor to reschedule the Work or contract completion time to reflect the changed conditions, and the Contractor shall revise the construction progress schedule and related items accordingly, at no additional cost to the Owner.
- N. Available float time may be used by the Owner through the Owner's Engineer.
- O. The Owner controls the float time and, therefore, without obligation to extend either the overall completion date or any intermediate completion dates, the Owner may initiate changes that absorb float time only. Owner initiated changes that affect the critical path on the network diagram shall be the sole grounds for extending the completion dates. Contractor initiated changes that encroach on the float time may be accomplished only with the Owner's concurrence. Such changes, however, shall give way to Owner initiated changes competing for the same float time.
- P. To the extent that the construction project schedule, or associated report or any revision thereof shows anything not jointly agreed upon or fails to show anything jointly agreed upon, it shall not be deemed to have been accepted by the Engineer. Failure to include on a schedule any element of Work required for the performance of this Contract shall not excuse the Contractor from completing all Work required within any applicable completion date, notwithstanding the review of the schedule by the Engineer.
- Q. Review and acceptance of the construction progress schedule, and related reports, by the Engineer is advisory only and shall not relieve the Contractor of the responsibility for accomplishing the Work within the contract completion date. Omissions and errors in the construction progress schedule, and related reports shall not excuse performance less than that required by the Contract and in no way make the Engineer an insurer of the Contractor's success or liable for time or cost overruns flowing from any shortcomings in the construction progress schedule, and related reports.
- R. The Contractor shall present and discuss the proposed schedule at the preconstruction conference.
- S. The construction progress schedule shall be based upon the precedence diagramming method of scheduling and shall be prepared in the form of a horizontal bar chart showing in detail the proposed sequence of the Work and identifying all construction activities included but not limited to yard piping, all structures and treatment units and all related Work specified herein to be performed under the Contract. The schedule shall be time scaled, identifying the first day of each week, with the estimated date of starting and

completion of each stage of the Work in order to complete the project within the contract time. The project critical path shall be clearly identified.

- T. The progress schedule shall be plotted on 22-inch by 34-inch and 11-inch by 17-inch paper and shall be revised and updated monthly, depicting progress through the last day of the current month and scheduled progress through completion. Six up to date copies of the schedule shall be submitted along with the application for monthly progress payments for the same period.
- U. The construction progress schedule shall be developed and maintained using MS-Project, Suretrak or equivalent software.

1.04 SCHEDULE OF PAYMENT ITEMS

- A. The Contractor shall submit a Schedule of Payment Items for review within two weeks after receiving the Notice to Proceed. The schedule shall contain the installed value of the component parts of Work for the purpose of making progress payments during the construction period and shall directly correlate on an item by item basis (unless otherwise accepted by the Engineer) to each individual activity detailed in the construction progress schedule. The sum of all scheduled items shall equal the total value of the Contract. Reference the Section entitled "Measurement and Payment" for further details.
- B. If the Contractor anticipates the need for payment for materials stored on the project site, it shall also submit a separate list covering the cost of materials, delivered and unloaded with taxes paid. This list shall also include the installed value of the item with coded reference to the Work items in the Schedule of Payment Items.
- C. The Contractor shall expand or modify the above schedule and materials listing as required by the Engineer's initial or subsequent reviews.

1.05 PROGRESS PAYMENT APPLICATIONS

- 1. Applications for payments shall be made to the Engineer for review in accordance with the Section entitled "Measurement and Payment".

1.06 SHOP DRAWINGS

- A. The Contractor shall submit for review shop drawings for concrete reinforcement, structural details, piping layout and appurtenances, wiring, color selection charts, materials and equipment fabricated especially for this Contract, and materials and equipment for which such Drawings are specified or specifically requested by the Engineer.
- B. Shop drawings shall show the principal dimensions, weight, structural and operating features, space required, clearances, type and/or brand of finish or shop coat, grease fittings, etc., depending on the subject of the Drawings.
- C. When so specified, or if considered by the Engineer to be acceptable, the manufacturer's specifications, catalog data, descriptive matter, illustrations, etc. may be submitted for review in place of shop drawings. In such case, the requirements shall be as specified for shop drawings, insofar as applicable.
- D. The Contractor shall be responsible for the prompt submittal of all shop drawings so that there shall be no delay to the Work due to the absence of such Drawings. The Engineer will review the shop drawings within 21 calendar days of receipt of such Drawings. Reviewed shop drawings will be returned to the Contractor by regular mail, posted no later than 21 days after receipt.

- E. Time delays caused by rejection of submittals are not cause for extra charges to the Owner or time extensions.
- F. Requirements: All shop drawings shall be submitted to the Engineer through the Contractor. The Contractor is responsible for obtaining shop drawings from its subcontractors and returning reviewed Drawings to them. All shop drawings shall be prepared on standard size, 22-inch by 34-inch sheets. All Drawings shall be clearly marked with the name of the project, Owner, Contractor, and building, equipment, or structure to which the drawing applies. Drawings shall be suitably numbered and stamped by the Contractor. Each shipment of Drawings shall be accompanied by a letter of transmittal giving a list of the drawing numbers and the names mentioned above.
- G. Product Data: Where manufacturer's publications in the form of catalogs, brochures, illustrations, or other data sheets are submitted in lieu of prepared shop drawings, such submission shall specifically indicate the particular item offered. Identification of such items and relative pertinent information shall be made with indelible ink. Submissions showing only general information will not be accepted.
- H. Product data shall include materials of construction, dimensions, performance characteristics, capacities, wiring diagrams, piping and controls, etc.
- I. Warranties: When warranties are called for, a sample of the warranty shall be submitted with the shop drawings. The sample warranty shall be the same form that will be used for the actual warranty. Actual warranties shall be originals and notarized.
- J. Work Prior to Review: No material or equipment shall be purchased, fabricated especially for this Contract, or delivered to the project site until the required shop drawings have been submitted, processed and marked either "FURNISH AS SUBMITTED" or "FURNISH AS CORRECTED". All materials and Work involved in the construction shall be as represented by said Drawings.
- K. The Contractor shall not proceed with any portion of the Work (such as the construction of foundations) for which the design and details are dependent upon the design and details of equipment for which submittal review has not been completed.
- L. Contractor's Review: Only submittals which have been checked and corrected should be submitted to the Contractor by its subcontractors and vendors. Prior to submitting shop drawings to the Engineer, the Contractor shall check thoroughly all such Drawings to satisfy itself that the subject matter thereof conforms to the Drawings and Specifications in all respects. Drawings which are correct shall be marked with the date, checker's name and indications of the Contractor's approval, and then shall be submitted to the Engineer. Other Drawings submitted to the Engineer will be returned to the Contractor unreviewed.
- M. Contractor's Responsibility: The Engineer's review of shop drawings will be general and shall not relieve the Contractor of the responsibility for details of design, dimensions, etc., necessary for proper fitting and construction of the Work required by the Contract and for achieving the specified performance.
- N. Contractor's Modifications: For submissions containing departures from the Contract Documents, the Contractor shall include proper explanation in its letter of transmittal. Should the Contractor submit for review equipment that requires modifications to the structures, piping, layout, etc. detailed on the Drawings, it shall also submit for review details of the proposed modifications. If such equipment and modifications are accepted, the Contractor, at no additional cost to the Owner, shall do all Work necessary to make such modifications.

- O. Substitutions: Whenever a particular brand or make of material, equipment, or other item is specified, or is indicated on the Drawings, it is for the purpose of establishing a standard of quality, design, and type desired and to supplement the detailed specifications. Any other brand or make which is equivalent to that specified or indicated may be offered as a substitute subject to the following provisions:
1. The Contractor shall submit for each proposed substitution sufficient details, complete descriptive literature, and performance data together with samples of the materials, where feasible, to enable the Engineer to determine if the proposed substitution is equal, in all respects including, but not limited to, quality, performance, ease of maintenance, availability of spare parts, and experience record.
 2. The Contractor shall submit certified tests, where applicable, by an independent laboratory attesting that the proposed substitution is equal.
 3. A list of installations where the proposed substitution is equal. Such listing shall cover a minimum of the previous five years and will furnish project names and contact phone numbers.
 4. Where the acceptance of a substitution requires excessive review by the Engineer, revision or redesign of any part of the Work, all such additional review costs, revisions and redesign, and all new Drawings and details required therefore, shall be at Contractor expense.
 5. In all cases the Engineer shall be the sole judge as to whether a proposed substitution is to be accepted. The Contractor shall abide by the Engineer's decision when proposed substitute items are judged to be unacceptable and shall in such instances furnish the item as specified. No substitute items shall be used in the Work without written acceptance of the Engineer.
 6. Acceptance of any proposed substitution shall in no way release the Contractor from any of the provisions of the Contract Documents.
 7. Owner may require, at Contractor's expense, a special performance guarantee or other surety with respect to any substitute.
- P. Complete Submittals: Each submittal shall be complete in all aspects incorporating all information and data required to evaluate the products' compliance with the Contract Documents. Partial or incomplete submissions shall be returned to the Contractor without review.
- Q. Shop Drawing Distribution: The Contractor shall submit shop drawings electronically to the Engineer for review. The method of electronic submittal shall be defined during the pre-construction meeting. Shop drawings will be reviewed by the Engineer, stamped and distributed with the appropriate box checked either "FURNISH AS SUBMITTED", "FURNISH AS CORRECTED" or "REVISE AND RESUBMIT". The contractor shall print and distribute shop drawings with the Engineer's review comments as needed.

1.07 WARRANTIES

- A. Warranties called for in the Contract Documents shall be originals and submitted to the Owner through the Engineer. When warranties are required they shall be submitted prior to request for payment.
- B. When advance copies of warranties are requested, they shall be submitted with, and considered as shop drawings.

1.08 CERTIFICATES

- A. Four copies of certificates of compliance and test reports shall be submitted for requested items to the Engineer prior to request for payment.

1.09 PRODUCT SAMPLES

- A. Contractor shall furnish for review all product samples as required by the Contract Documents or requested by the Engineer to determine compliance with the specifications.
- B. Samples shall be of sufficient size or quantity to clearly illustrate the quality, type, range of color, finish or texture and shall be properly labeled to show complete project identification, the nature of the material, trade name of manufacturer and location of the Work where the material represented by the sample will be used.
- C. Samples shall be checked by the Contractor for conformance to the Contract Documents before being submitted to the Engineer and shall bear the Contractor's stamp certifying that they have been so checked. Transportation charges on samples submitted to the Engineer shall be prepaid by the Contractor.
- D. Engineer's review will be for compliance with the Contract Documents, and its comments will be transmitted to the Contractor with reasonable promptness.
- E. Acceptable samples will establish the standards by which the completed Work will be judged.

1.10 OPERATION AND MAINTENANCE MANUALS

- A. General: The Contractor shall furnish and deliver to the Engineer two (2) complete Operation and Maintenance (O&M) Manuals for the substantial, complete systems including instructions, technical bulletins, and any other printed matter such as diagrams, prints or drawings, containing full information required for the proper operations, maintenance, and repair of all Contractor furnished equipment. Also included shall be a spare parts diagram and complete spare parts list. These requirements are a prerequisite to the operation and acceptance of equipment. Each O&M Manual shall be bound together in appropriate three-ring hard cover binders. A detailed table of contents shall be provided for each Manual. Provide an appropriate label on the binder edge. Provide tabs and separate sections for operation, maintenance, spare parts, etc.
- B. Written operations and maintenance instructions are required for all equipment items supplied for this project. The amount of detail shall be commensurate with the complexity of the equipment item. Extensive pictorial cuts of equipment are required for operator reference in servicing.
- C. Information not applicable to the specific piece of equipment installed on this project shall be struck from the Manual by the Contractor. Information provided shall include a source of replacement parts and names of service representatives, including addresses and telephone numbers.
- D. When written instructions include shop drawings and other information previously reviewed by the Engineer, only those editions which were accepted by the Engineer, and which accurately depict the equipment installed, shall be incorporated in the O&M Manual.
- E. Maintenance and Lubrication Schedules: The Contractor shall include in the O&M Manual, for all Contractor furnished mechanical and electrical equipment including switchgear and motor control centers, instrumentation, valves, gates, etc., complete maintenance and lubrication schedules. Separate forms will be submitted for each piece of equipment.

- F. The Contractor shall include in the O&M Manual, for all Contractor furnished pumps and motors, complete data sheets. Separate forms shall be submitted for each different type and size of pump and motor. Sample forms are included at the end of this section.
- G. All Final O&M Manuals shall also be submitted in whole in electronic format on compact disk. Electronic O&M manuals shall contain information in standard formats (Adobe PDF, Word, AutoCAD, HTML, etc.) and shall be easily accessible using standard, "off-the-shelf" software such as an Internet browser. PDF format documents shall be searchable. Hypertext links shall be embedded throughout the text for ease of navigation between references.

1.11 RECORD DRAWINGS

- A. The Contractor shall keep and maintain, at the job site, one record set of Drawings. On these, it shall mark all project conditions, locations, configurations, and any other changes or deviations which may vary from the details represented on the original Contract Drawings, including buried or concealed construction and utility features which are revealed during the course of construction. Special attention shall be given to recording the horizontal and vertical location of all buried utilities that differ from the locations indicated, or which were not indicated on the Drawings. Said record drawings shall be supplemented by detailed sketches as necessary or directed to indicate, fully, the Work as actually constructed. These master record drawings of the Contractor's representation of as-built conditions, including all revisions made necessary by addenda and change orders shall be maintained up-to-date during the progress of the Work.
- B. At a minimum the record drawings shall be reviewed on the 20th working day of every third month after the month in which the final Notice-to-Proceed is given as well as on completion of Work. Failure to maintain the record drawings up-to-date shall be grounds for withholding monthly progress payments until such time as the record drawings are brought up-to-date.
- C. Record drawings shall be accessible to the Engineer at all times during the construction period.
- D. Final payment will not be acted upon until the Contractor-prepared record drawings have been delivered to the Engineer. Said up-to-date record drawings shall be in the form of a set of prints with carefully plotted information overlaid in pencil.
- E. Upon substantial completion of the Work and prior to final acceptance, the Contractor shall finalize and deliver a complete set of record drawings to the Engineer for transmittal to the Owner, conforming to the construction records of the Contractor. This set of drawings shall consist of corrected drawings showing the reported location of the Work. The information submitted by the Contractor and incorporated in the Record Drawings will be assumed to be correct, and the Engineer will not be responsible for the accuracy of such information, and for any errors or omissions which may appear on the Record Drawings as a result.

1.12 SUPPLEMENTS

- A. The supplements listed below following "END OF SECTION" are part of this Specification.
 - 1. Forms: Transmittal of Contractor's submittal.

PART 2 - PRODUCTS (Not Used)

PART 3 -- EXECUTION (Not Used)

- END OF SECTION -

TRANSMITTAL OF CONTRACTOR'S SUBMITTAL

(Attach to Each Submittal)

DATE: _____

TO: _____

Submittal No. _____

1 New Submittal 1 Resubmittal

Previous Submittal No.: _____

Project: No. _____

Project No.: _____

Specification Section No.: _____

FROM: _____

(Cover only one section with each transmittal)
Schedule Date of Submittal

Contractor

SUBMITTAL TYPE: 1 Shop Drawing 1 Contract Closeout 1 "Or-Equal"/Substitute
1 Quality Control 1 Sample

The following items are hereby submitted:

Number of Copies	Description of Item Submitted (Type, Size, Model Number, Etc.)	Spec. Para. No.	Drawing or Brochure Number	Contains Variation to Contract	
				No	Yes

Contractor hereby certifies that (i) Contractor has complied with the requirements of Contract Documents in preparation, review, and submission of designated Submittal and (ii) the Submittal is complete and in accordance with the Contract Documents and requirements of laws and regulations and governing agencies.

By: _____

Contractor (Authorized Signature)

SECTION 01400 - QUALITY CONTROL

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Testing Laboratory Services

1. Laboratory testing and checking required by the Specifications, including the cost of transporting all samples and test specimens, shall be provided and paid for by the CONTRACTOR unless otherwise indicated in the Specifications.
2. Materials to be tested include, but are not necessarily limited to, the following: cement, concrete aggregate, concrete, bituminous paving materials, structural and reinforcing steel, waterproofing, select backfill, crushed stone or gravel and sand.
3. Tests required by the OWNER shall not relieve the CONTRACTOR from the responsibility of supplying test results and certificates from manufacturers or suppliers to demonstrate conformance with the Specifications.
4. Procedure
 - a. The CONTRACTOR shall plan and conduct his operations to permit taking of field samples and test specimens, as required, and to allow adequate time for laboratory tests.
 - b. The collection, field preparation and storage of field samples and test specimens shall be as directed by the ENGINEER with the cooperation of the CONTRACTOR.
5. Significance of Tests
 - a. Test results shall be binding on both the CONTRACTOR and the OWNER, and shall be considered irrefutable evidence of compliance or noncompliance with the Specification requirements, unless supplementary testing shall prove, to the satisfaction of the OWNER, that the initial samples were not representative of actual conditions.
6. Supplementary and Other Testing
 - a. Nothing shall restrict the CONTRACTOR from conducting tests he may require. Should the CONTRACTOR at any time request the OWNER to consider such test results, the test reports shall be certified by an independent testing laboratory acceptable to the OWNER. Testing of this nature shall be conducted at the CONTRACTOR's expense.

1.02 IMPERFECT WORK, EQUIPMENT, OR MATERIALS

- A. Any defective or imperfect work, equipment, or materials furnished by the CONTRACTOR which is discovered before the final acceptance of the work, as established by the Certificate of Substantial Completion, or during the subsequent guarantee period, shall be removed immediately even though it may have been overlooked by the ENGINEER and estimated for payment. Any equipment or materials condemned or rejected by the ENGINEER shall be tagged as such and shall be immediately removed from the site. Satisfactory work or materials shall be substituted for that rejected.
- B. The ENGINEER may order tests of imperfect or damaged work, equipment, or materials to determine the required functional capability for possible acceptance, if there is no other reason for rejection. The cost of such tests shall be borne by the CONTRACTOR; and the nature, tester, extent and supervision of the tests will be as determined by the ENGINEER. If the results of the tests indicate that the required functional capability of the work, equipment, or material was not impaired, consistent with the final general appearance of same, the work, equipment, or materials may be deemed acceptable. If the results of such tests reveal that the required functional capability of the questionable work, equipment, or materials has been impaired, then such work, equipment, or materials shall be deemed imperfect and shall be replaced. The CONTRACTOR may elect to replace the imperfect work, equipment, or material in lieu of performing the tests.

1.03 INSPECTION AND TESTS

- A. The CONTRACTOR shall allow the ENGINEER ample time and opportunity for testing materials and equipment to be used in the work. He shall advise the ENGINEER promptly upon placing orders for material and equipment so that arrangements may be made, if desired, for inspection before shipment from the place of manufacture. The CONTRACTOR shall at all times furnish the ENGINEER and his representatives, facilities including labor, and allow proper time for inspecting and testing materials, equipment, and workmanship. The CONTRACTOR must anticipate possible delays that may be caused in the execution of his work due to the necessity of materials and equipment being inspected and accepted for use. The CONTRACTOR shall furnish, at his own expense, all samples of materials required by the ENGINEER for testing, and shall make his own arrangements for providing water, electric power, or fuel for the various inspections and tests of structures and equipment.
- B. The CONTRACTOR shall furnish the services of representatives of the manufacturers of certain equipment, as prescribed in other Sections of the Specifications. The CONTRACTOR shall also place his orders for such equipment on the basis that, after the equipment has been tested prior to final acceptance of the work, the manufacturer will furnish the OWNER with certified statements that the equipment has been installed properly and is ready to be placed in functional operation. Tests and analyses required of equipment shall be paid for by the CONTRACTOR, unless specified otherwise in the Section which covers a particular piece of equipment.
- C. Where other tests or analyses are specifically required in other Sections of these Specifications, the cost thereof shall be borne by the party (OWNER or CONTRACTOR)

so designated in such Sections. The OWNER will bear the cost of all tests, inspections, or investigations undertaken by the order of the ENGINEER for the purpose of determining conformance with the Contract Documents if such tests, inspection, or investigations are not specifically required by the Contract Documents, and if conformance is ascertained thereby. Whenever nonconformance is determined by the ENGINEER as a result of such tests, inspections, or investigations, the CONTRACTOR shall bear the full cost thereof or shall reimburse the OWNER for said cost. In this connection, the cost of any additional tests and investigations, which are ordered by the ENGINEER to ascertain subsequent conformance with the Contract Documents, shall be borne by the CONTRACTOR.

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

SECTION 01510 - UTILITIES AND SERVICES

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall provide for utilities and services for its own operations. These shall include electrical power, water, ventilation, sanitary facilities and telephone service. The Contractor shall furnish, install and maintain all temporary utilities during the contract period including removal upon completion of the work. Such facilities shall comply with regulations and requirements of the National Electrical Code, OSHA, Florida Power and Light, and applicable Federal, State and all jurisdictional codes.

1.02 TEMPORARY POWER

- A. The Contractor shall arrange with Florida Power and Light (FPL) for construction period service and pay all costs for the work and power. The Contractor shall arrange and pay for a separate feeder to supply power from off-site directly from FPL service to the Contractor temporary power system. In addition to providing for a safe construction period distribution system the Contractor shall provide a safe and adequate artificial lighting system for work areas which do not have sufficient natural light.

1.03 TEMPORARY WATER

- A. The Contractor shall supply all water used for construction, flushing, testing, and temporary sanitary facilities. The Contractor shall provide and maintain all piping, fittings, adapters, and valving required. It is the Contractor's responsibility to arrange through the Owner, for location and installation of a 2-inch water meter and backflow preventer at the fire hydrant shown on the drawings. A deposit to be paid by the Contractor is required for meter rental and all water shall be purchased at the prevailing rates.

1.04 TEMPORARY SANITARY FACILITIES

- A. The Contractor shall provide and maintain adequate and clean sanitary facilities for the construction work force and visitors. The facilities shall comply with local codes and regulations and be situated at approved locations.

1.05 SECURITY

- A. The Contractor shall install fences and employ security guards to protect the job site against vandalism, burglary, theft, trespassing, as required. The Contractor shall care for and protect against loss or damage of all material to be incorporated in the construction, the existing structures, equipment and materials for the duration of the Contract, and shall repair or replace damaged or lost materials and damage to structures.
- B. The Contractor shall be responsible for providing, maintaining and securing gates used for construction purposes for the duration of the project as required for security purposes. Reference the drawings for additional requirements.

1.06 STAGING AREA

- A. The Contractor can establish staging area(s) suitable for the storage of materials and equipment associated with the project, as defined on the Drawings, and shall be fully responsible for abiding all applicable rules, regulations and conditions having jurisdictional control at the site chosen.
- B. The Contractor shall be aware that the staging area shall be limited to the area(s) defined

on the Drawings. The Contractor shall arrange, coordinate and take all necessary steps regarding its work effort to work within these site constraints, including off-site parking and material equipment storage, as may required to complete the work. Costs associated with these efforts shall be included in the base bid items for this project.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

- END OF SECTION -

SECTION 01530 - PROTECTION OF EXISTING FACILITIES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall be responsible for the preservation and protection of property adjacent to the work site against damage or injury as a result of its operations under this Contract. Any damage or injury occurring on account of any act, omission or neglect on the part of the CONTRACTOR shall be restored in a proper and satisfactory manner or replaced by and at the expense of the CONTRACTOR to an equal or superior condition than previously existed.
- B. The CONTRACTOR shall comply promptly with such safety regulations as may be prescribed by the OWNER or the local authorities having jurisdiction and shall, when so directed, properly correct any unsafe conditions created by, or unsafe practices on the part of, its employees. In the event of the CONTRACTOR's failure to comply, the OWNER may take the necessary measures to correct the conditions or practices complained of, and all costs thereof will be deducted from any monies due the CONTRACTOR. Failure of the ENGINEER to direct the correction of unsafe conditions or practices shall not relieve the CONTRACTOR of its responsibility hereunder.
- C. In the event of any claims for damage or alleged damage to property as a result of work under this Contract, the CONTRACTOR shall be responsible for all costs in connection with the settlement of or defense against such claims. Prior to commencement of work in the vicinity of property adjacent to the work site, the CONTRACTOR, at its own expense, shall take such surveys as may be necessary to establish the existing condition of the property. Before final payment can be made, the CONTRACTOR shall furnish satisfactory evidence that all claims for damage have been legally settled or sufficient funds to cover such claims have been placed in escrow, or that an adequate bond to cover such claims has been obtained.

1.02 PROTECTION OF WORK AND MATERIAL

- A. During the progress of the work and up to the date of final payment, the CONTRACTOR shall be solely responsible for the care and protection of all work and materials covered by the Contract.
- B. All work and materials shall be protected against damage, injury or loss from any cause whatsoever, and the CONTRACTOR shall make good any such damage or loss at its own expense. Protection measures shall be subject to the approval of the ENGINEER.

1.03 BARRICADES, WARNING SIGNS AND LIGHTS

- A. The CONTRACTOR shall provide, erect and maintain as necessary, strong and suitable barricades, danger signs and warning lights along all roads accessible to the public, as required by the authority having jurisdiction, to insure safety to the public. All barricades

and obstructions along public roads shall be illuminated at night and all lights for this purpose shall be kept burning from sunset to sunrise.

- B. Each CONTRACTOR shall provide and maintain such other warning signs and barricades in areas of and around their respective work as may be required for the safety of all those employed in the work, OWNER operating personnel, or those visiting the site.

1.04 TEMPORARY BRIDGES

- A. Construct temporary bridges at all points where maintenance of traffic across pipeline construction is necessary.
- B. Make bridges over public streets, roads, and highways acceptable to authority having jurisdiction thereover.
- C. Bridges erected over private roads and driveways shall be adequate for service to which they will be subjected.
- D. Provide substantial guardrails and suitably protected approaches.
- E. Provide foot bridges not less than 4 feet wide with handrails and uprights of dressed lumber.
- F. Maintain bridges in place as long as conditions of the Work require their use for safety of public, except that when necessary for proper prosecution of the Work in immediate vicinity of bridge. Bridge may be relocated or temporarily removed for such period as ENGINEER may permit.

1.05 EXISTING UTILITIES AND STRUCTURES

- A. The term existing utilities shall be deemed to refer to both publicly-owned and privately-owned utilities such as electric power and lighting, telephone, water, gas, storm drains, process lines, sanitary sewers and all appurtenant structures.
- B. Where existing utilities and structures are indicated on the Drawings, it shall be understood that all of the existing utilities and structures affecting the work may not be shown and that the locations of those shown are approximate only. It shall be the responsibility of the CONTRACTOR to ascertain the actual extent and exact location of existing utilities and structures. In every instance, the CONTRACTOR shall notify the proper authority having jurisdiction and obtain all necessary directions and approvals before performing any work in the vicinity of existing utilities.
- C. Prior to beginning any excavation work, the CONTRACTOR shall, through field investigations, determine any conflicts or interferences between existing utilities and new utilities to be constructed under this project. This determination shall be based on the actual locations, elevations, slopes, etc., of existing utilities as determined in the field investigations, and locations, elevation, slope, etc. of new utilities as shown on the Drawings. If interference exists, the CONTRACTOR shall bring it to the attention of the

ENGINEER as soon as possible. If the ENGINEER agrees that interference exists, it shall modify the design as required.

Additional costs to the CONTRACTOR for this change shall be processed through a Change Order as detailed elsewhere in these Contract Documents. In the event the CONTRACTOR fails to bring a potential conflict or interference to the attention of the ENGINEER prior to beginning excavation work, any actual conflict or interference which does arise during the Project shall be corrected by the CONTRACTOR, as directed by the ENGINEER, at no additional expense to the OWNER.

- D. The work shall be carried out in a manner to prevent disruption of existing services and to avoid damage to the existing utilities. Temporary connections shall be provided, as required, to insure uninterrupted of existing services. Any damage resulting from the work of this Contract shall be promptly repaired by the CONTRACTOR at its own expense in a manner approved by the ENGINEER and further subject to the requirements of any authority having jurisdiction. Where it is required by the authority having jurisdiction that they perform their own repairs or have them done by others, the CONTRACTOR shall be responsible for all costs thereof.
- E. Where excavations by the CONTRACTOR require any utility lines or appurtenant structures to be temporarily supported and otherwise protected during the construction work, such support and protection shall be provided by the CONTRACTOR. All such work shall be performed in a manner satisfactory to the ENGINEER and the respective authority having jurisdiction over such work. In the event the CONTRACTOR fails to provide proper support or protection to any existing utility, the ENGINEER may, at its discretion, have the respective authority to provide such support or protection as may be necessary to insure the safety of such utility, and the costs of such measures shall be paid by the CONTRACTOR.
- F. Protection of existing utilities, structures and other facilities: The underground pipes, utilities and structures shown on the Plans are located according to the best information available, but may vary by several feet from both the position and elevation shown. The CONTRACTOR shall explore far enough ahead of its work to determine the exact location and condition of such utilities, structures or facilities so that, before the Work is installed, the ENGINEER may change the line or grade of the pipe or other facility, should that become necessary to avoid a conflict. Should this exploration reveal that adjustments to the work are necessary; the CONTRACTOR shall immediately notify the ENGINEER and coordinate with him to adjust the work in a timely fashion avoiding delays to construction. No request for additional compensation or Contract time (except for a non-compensable time extension at the sole discretion of the ENGINEER, whose decision shall be final) resulting from encountering utilities or structures not shown, or differing in location or elevation from that shown, will be considered. The CONTRACTOR shall explore sufficiently ahead of the Work to allow time for any necessary adjustment without delay occasioned by encountering underground utilities or structures which could have or should have been discovered by timely exploration ahead of the Work shall rest solely with the CONTRACTOR.

- G. Relocation of existing utilities: The relocation of existing utilities, as noted on the Plans, or for the convenience of the CONTRACTOR shall be the responsibility of the CONTRACTOR. This work shall be completed by either the forces of the existing utility or the CONTRACTOR's forces at the discretion of the responsible utility. If the work is to be performed by the CONTRACTOR, all work shall be done in accordance with the utility company's requirements. Under no circumstances shall the CONTRACTOR be authorized extra payment for this work, and all cost for the relocation shall be the responsibility of the CONTRACTOR.
- H. Any conflicts between the field investigation and the information shown on the Plans shall be brought to the immediate attention of the ENGINEER

1.06 TREES WITHIN PROJECT LIMITS

- A. General: The CONTRACTOR shall exercise all necessary precautions so as not to damage or destroy any trees on the project site, and shall not trim or remove any trees unless such trees have been approved for trimming or removal by the jurisdictional agency or OWNER. All existing trees which are damaged during construction shall be replaced by the CONTRACTOR or a certified tree company to the satisfaction of the OWNER.
- B. Replacement: The CONTRACTOR shall immediately notify the OWNER if any tree is damaged by the CONTRACTOR's operations. If, in the opinion of the OWNER, the damage is such that replacement is necessary, the CONTRACTOR shall replace the tree at its own expense. The tree shall be of a like size and variety as the tree damaged, or, if of a smaller size, the CONTRACTOR shall pay to the OWNER compensatory payment acceptable to the OWNER.

1.07 NOTIFICATION BY THE CONTRACTOR

- A. Prior to any excavation in the vicinity of any existing underground facilities, including all water, sewer, storm drain, gas, petroleum products, or other pipelines; all buried electric power, communications, or television cables; all traffic signal and street lighting facilities; and all roadway and state highway rights-of-way the CONTRACTOR shall notify the respective authorities representing the owners or agencies responsible for such facilities not less than three days nor more than seven days prior to excavation so that a representative

1.08 DETOURS

- A. Where authority having jurisdiction requires that traffic be maintained over construction work in a public street, road, or highway, and traffic cannot be maintained on original roadbed or pavement, construct and maintain detour around the Work. Coordinate traffic routing with that of others working in same or adjacent areas.

1.09 RESTORATION OF PAVEMENT

- A. General: All paved areas including asphaltic concrete berms cut or damaged during construction shall be replaced with similar materials and of equal thickness to match the existing adjacent undisturbed areas, except where specific resurfacing requirements have

been called for in the Contract Documents. All pavements which are subject to partial removal shall be neatly saw cut in straight lines.

- B. Temporary Resurfacing: Wherever required by the public authorities having jurisdiction, the CONTRACTOR shall place temporary surfacing, signage, striping and/or other traffic controls as required, promptly after backfilling and shall maintain such surfacing for the period of time fixed by said authorities before proceeding with the final restoration of improvements.
- C. Permanent Resurfacing: In order to obtain a satisfactory junction with adjacent surfaces, the CONTRACTOR shall saw cut back and trim the edge so as to provide a clean, sound, vertical joint before permanent replacement of an excavated or damaged portion of pavement. Damaged edges of pavement along excavations and elsewhere shall be trimmed back by saw cutting in straight lines. All pavement restoration and other facilities restoration shall be constructed to finish grades compatible with adjacent undisturbed pavement.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

- END OF SECTION -

SECTION 01532 – WELLFIELD PROTECTION

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor is advised that the work is to be performed in a fully operational wellfield, which is the principal source of raw water supply to the City of Hallandale Beach, Florida. The Contractor shall be fully responsible for all precautionary measures together with all remediation, cleanup, disinfection, regulatory agency fines and all other labor, materials, and costs associated with any contamination of the potable water supply caused directly or indirectly by the activities of the Contractor in the performance of the work.
- B. Notwithstanding other indemnification requirements of the Contract Documents, the Contractor shall also indemnify, defend, and hold harmless the Owner, the Engineer and the Owner's agents from any and all legal action which may arise from contamination of the water supply caused directly or indirectly by the Contractor in the performance of the work.
- C. The Contractor is notified of the following:
 - 1. The work shown on the contract drawings will be within a wellfield protection zone as defined by Broward County.
 - 2. The Contractor shall comply with all requirements of Chapter 27, Article XIII Wellfield Protection of the Broward County Code and Chapter 62-521, Wellhead Protection Rule of the Florida Administrative Code.
 - 3. The Contractor shall review the Broward County Wellfield Protection Program literature and the List of Regulated Substances. The Contractor shall review the chemicals and products they intend to use during construction and determine if they are included on the List of Regulated Substances. A copy of the List of Regulated Substances associated with Wellfield Protection can be obtained from Broward County.
 - 4. The Contractor shall complete an affidavit on their letterhead, signed by an authorized officer of the firm which itemizes the regulated chemicals that the Contractor proposes to use during construction, if applicable.
 - 5. Submit the affidavit in accordance with the Section entitled "Submittals".
 - 6. Submit to the Broward County Environmental Protection and Growth Management Department the affidavit and other information as required to acquire permission to initiate construction within the wellfield.
 - 7. Contact Broward County Protection and Growth Management Department for additional assistance regarding compliance with the Wellfield Protection ordinance.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

- END OF SECTION -

SECTION 01570

TRAFFIC REGULATIONS AND MAINTENANCE OF TRAFFIC

PART 1 -- GENERAL

1.01 TRAFFIC CONTROL

- A. The Contractor shall obey all traffic laws and comply with all the requirements, rules, and regulations of the Florida Department of Transportation, Broward County, and other local authorities having jurisdiction, to maintain adequate warning signs, lights, barriers, etc., for the protection of vehicular, bicycle and pedestrian traffic in public Rights of Way in the project areas.
- B. All traffic control devices, warning devices, safety devices and barriers shall meet the requirements of National Cooperative Highway Research Report 350 (NCHRP 350), current Manual of Uniform Traffic Control Devices and any current FHWA directives.
- C. The Contractor shall develop, or have developed, a Traffic Control Plan and submit to the Engineer or Owner for approval. The Traffic Control Plan shall meet the requirements of Index 600 of the latest edition of the Florida Department of Transportation Design Standards. The Traffic Control Plan shall be on 11"x17" plan sheets and have separate sheets for each phase of construction (if applicable). The Contractor shall take responsibility for identifying and assessing any potential impacts to any utilities that may be caused by the Traffic Control Plan; the Contractor shall be responsible for notifying the Town of Jupiter in writing if any such potential impacts to utilities.
- D. The Contractor shall maintain traffic and protect the public from all damage to persons and property within the Contract Limits, in accordance with the Contract Documents and all applicable state, county, and local regulations. The Contractor shall install and maintain adequate traffic control devices, warning devices and barriers to protect the traveling public and workers, and to safeguard the work area. Erect the required traffic control devices, warning devices and barriers to prevent any hazardous conditions and in conjunction with any necessary traffic re-routing. Use only those devices that are included in 600 series in the latest edition of the Design Standards of Florida Department of Transportation. He shall conduct his operations so as to maintain and protect access for vehicular and pedestrian traffic, to and from all properties and business establishments adjoining or adjacent to those streets affected by his operations, and to subject the public to a minimum of delay and inconvenience. Suitable signs, barricades, railing, etc., shall be erected and the work outlined by adequate lighting at night. Danger lights shall be provided as required. Watchmen and flagmen shall be provided as may be necessary for the protection of traffic.
- E. The Contractor shall notify the Engineer or Owner of any scheduled operation, which will affect traffic patterns or safety, sufficiently in advance of commencing such operation to permit his review of the plan for the proposed installation of traffic control devices, warning devices or barriers.

- F. The Contractor shall have an employee assigned the responsibility of maintaining the position and condition of all traffic control devices, warning devices and barriers throughout the duration of the Contract. The Contractor shall keep the Engineer or Owner advised at all times of the identification and means of contacting this employee on a 24-hour basis.
- G. The Contractor shall keep control devices, warning devices, safety devices and barriers in the correct position, properly directed, clearly visible and clean, at all times. Immediately repair, replace or clean damaged, defaced or dirty devices or barriers.
- H. The Contractor shall be responsible for enforcing on-site parking regulations. The Contractor and his personnel are cautioned against parking vehicles in business zones for extended periods of time. If necessary, the Contractor shall obtain off-site parking areas for his personnel.
- I. All dirt spilled from the Contractor's trucks onto existing pavements shall be removed by the Contractor whenever, in the opinion of the Owner, the accumulation is sufficient to cause the formation of mud, dust, or interference with traffic or create a traffic hazard.

1.02 DETOURS

- A. Where authority having jurisdiction requires that traffic be maintained over construction work in a public street, road, or highway, and traffic cannot be maintained on original roadbed or pavement, construct and maintain detour around the Work. Coordinate traffic routing with that of others working in same or adjacent areas.

1.03 PEDESTRIAN TRAFFIC

- A. The Traffic Control Plan, provided by the Contractor, shall include provisions for pedestrian and transit vehicular traffic where applicable as described herein.
- B. The Contractor shall be responsible for providing a safe and adequate walking surface applicable to the Americans with Disabilities Act (ADA) for pedestrians. Safe walk routes for all pedestrians and transit users within the vicinity of the construction zone shall be maintained throughout construction. This includes safe walk routes/access to and from existing bus stops and transit vehicles. If the current walking surface and access to and from transit vehicles at bus stops cannot be maintained, then a temporary road-rock 4-foot walkway shall be created. The safe walk route shall be separated from the construction activity by the 4-foot high orange construction fence for the entire length of the project or the length of the walk route, whichever is less.
- C. Pedestrian walkways, bus stops and pedestrian access to transit vehicles should be maintained free of any obstructions and hazards such as holes, debris, mud, construction equipment, stored materials, etc. Any hazards near or adjacent to walkways, bus stops and access to transit vehicles should be clearly delineated.
- D. Where safe pedestrian access/walkways cannot be provided, pedestrians should be directed to alternative routes by appropriate traffic control devices. Pedestrian, bicycle, and wheelchair traffic shall be guided and maintained (special attention is directed to the existing bus stop locations access, where applicable) using approved warning lights,

signing, and channelization devices. Such control devices shall be installed and maintained in accordance with the MUTCD sections on work zone traffic control for pedestrians.

- E. Where construction activities involve consecutive bus stops, access to and from all bus stops should be maintained. If access to and from all bus stops cannot be maintained, then a bus stop may be temporarily relocated or removed. However, no two consecutive bus stop shall be affected in this manner. If a stop requires temporary removal or relocation, then Broward County should be notified 30 days prior to the occurrence.
- F. It shall be the responsibility of the Contractor to install any necessary pavement, road rock, pavement marking and signage and/or any pedestrian signalization and/or signal modification to accommodate an existing or alternate walk route.
- G. Thirty days prior to the beginning of construction the Contractor shall notify the Broward County, to arrange a pre-construction - transit route/pedestrian access safety meeting. This meeting is to determine all bus routes affected and to make any necessary arrangements for rerouting and temporary signing

PART 2 -- PRODUCTS - (Not Used)

PART 3 -- EXECUTION - (Not Used)

- END OF SECTION -

SECTION 01600 - MATERIALS AND EQUIPMENT

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall furnish, install, test, and place in acceptable operation all material and equipment and all necessary accessories as specified herein, as shown on the Drawings, and as required for a complete and operable system.
- B. The equipment shall be provided complete with all accessories, special tools, spare parts, mountings, and other appurtenances as specified, and as may be required for a complete and operating installation.
- C. It is the intent of these Specifications that the CONTRACTOR shall provide the OWNER complete and operational equipment/systems. To this end, it is the responsibility of the CONTRACTOR to provide necessary ancillary items such as controls, wiring, etc., to make each piece of equipment operational as intended by the Specifications.
- D. Furnish and Install
 - 1. Where the words "furnish", "provide", "supply", "replace", or "install" are used, whether singularly or in combination, they shall mean to furnish and install, unless specifically stated otherwise.
 - 2. In the interest of brevity, the explicit direction "to furnish and install" has sometimes been omitted in specifying materials and/or equipment herein. Unless specifically noted otherwise, it shall be understood that all equipment and/or materials specified or shown on the Drawings shall be furnished and installed under the Contract as designated on the Drawings.

1.02 JOB SITE DELIVERY TIMING

- A. Equipment and materials to be incorporated into the work shall be delivered sufficiently in advance of their installation and use to prevent delay in the execution of the work, and they shall be delivered as nearly as feasible in the order required for executing the work.
- B. The CONTRACTOR shall not deliver to the job site equipment and materials that are not scheduled to be incorporated into the work within the following 120 calendar days.

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. All equipment, materials, and installations shall conform to the requirements of the most recent editions with latest revisions, supplements, and amendments of the specifications, codes, and standards listed in Section 01090, Reference Standards.

1.04 SHOP DRAWINGS

- A. Shop Drawings, descriptive data, dimensions, parts, performance characteristics, material Specifications, construction details, piping and wiring diagrams, and associated items, as appropriate, showing conformance of all equipment to the Contract Documents, shall be submitted to the ENGINEER for review in accordance with Section 01300, Submittals. Additional required information shall include: the horsepower, voltage, and rotative speed of the motor along with other pertinent motor data, and the total weight of the equipment plus the approximate weight of the shipped materials. Shop Drawings shall also include complete erection, installation, and adjustment instructions, and recommendations.
- B. SHOP DRAWINGS ON ITEMS REQUIRING PERFORMANCE AFFIDAVITS WILL NOT BE REVIEWED UNTIL ACCEPTABLE PERFORMANCE AFFIDAVITS ARE RECEIVED.

1.05 COORDINATION

- A. The CONTRACTOR shall coordinate all details, locations, field measurements and other conditions with various equipment suppliers, so that the equipment supplied functions as part of a complete system.

1.06 SERVICES OF THE MANUFACTURER'S REPRESENTATIVE

- A. The CONTRACTOR shall provide the services of a qualified manufacturer's representative who shall adequately supervise the installation and testing of all equipment furnished under this Contract and instruct the OWNER's operating personnel in its maintenance and operation as outlined in Section 01660 – Equipment Testing and Startup. The Contract prices for equipment shall include the cost of furnishing the manufacturer's representative for the number of days specified in the individual equipment specifications. Any additional time required to achieve successful installation and operation shall be at the expense of the CONTRACTOR.
- B. The manufacturer's representative shall sign in and out at the office of the ENGINEER's Resident Project Representative on each day he is at the project.
- C. The times specified for services by the manufacturer's technical representative herein or in the equipment specifications are exclusive of travel time to and from the facility and shall not be construed as to relieve the manufacturer of any additional visits to provide sufficient service to place the equipment in satisfactory operation.
- D. The CONTRACTOR shall notify manufacturers or suppliers that they will be required to state and guarantee a firm delivery date for all equipment that they offer to furnish. Delivery dates shall be as required by the CONTRACTOR to meet the approved progress schedule.
- E. Unless otherwise referenced in the individual equipment specification section, the services of the manufacturer's representative shall be provided for a period as stated in the following schedule:

Item	Duration (days)
1. Proper Installation Check and Functional Test	1
2. Performance Test	1
3. Operation and Maintenance Training	1

1.07 SUBSTITUTIONS

- A. Requests for substitutions of equipment or materials shall conform to the requirements of the General Conditions, Supplemental Conditions, and as hereinafter specified.
 1. CONTRACTOR shall submit for each proposed substitution sufficient details, complete descriptive literature and performance data together with samples of the materials, where feasible, to enable the OWNER and ENGINEER to determine if the proposed substitution is equal.
 2. CONTRACTOR shall submit certified tests, where applicable, by an independent laboratory attesting that the proposed substitution is equal.
 3. A list of installations where the proposed substitution is equal.
 4. Requests for substitutions shall include full information concerning differences in cost, and any savings in cost resulting from such substitutions shall be passed on to the OWNER.
- B. Where the approval of a substitution requires revision or redesign of any part of the work, including that of other Contracts, all such revision and redesign, and all new drawings and details therefore, shall be provided by the CONTRACTOR at his own cost and expense, and shall be subject to the approval of the OWNER and ENGINEER.
- C. In the event that the ENGINEER is required to provide additional engineering services, then the ENGINEER's charges for such additional services shall be charged to the CONTRACTOR by the OWNER in accordance with the requirements of the General Conditions, and the Supplemental Conditions.
- D. In all cases the OWNER and ENGINEER shall be the judge as to whether a proposed substitution is to be approved. The CONTRACTOR shall abide by their decision when proposed substitute items are judged to be unacceptable and shall in such instances furnish the item specified or indicated. No substitute items shall be used in the work without written approval of the OWNER and ENGINEER.
- E. CONTRACTOR shall have and make no claim for an extension of time or for damages by reason of the time taken by the ENGINEER in considering a substitution proposed by the CONTRACTOR or by reason of the failure of the ENGINEER to approve a substitution proposed by the CONTRACTOR.

- F. Acceptance of any proposed substitution shall in no way release the CONTRACTOR from any of the provisions of the Contract Documents.

PART 2 -- PRODUCTS

2.01 GENERAL

- A. All parts of the equipment furnished shall be amply designed and constructed for the maximum stresses occurring during fabrication, erection, and continuous operation.
- B. All materials shall be new and both workmanship and materials shall be of the very best quality, entirely suitable for the service to which the unit is to be subjected and shall conform to all applicable sections of these Specifications.
- C. All parts of duplicate equipment shall be interchangeable without modification. Manufacturer's design shall accommodate all the requirements of these Specifications.
- D. All bearings and moving parts shall be adequately protected by bushings or other approved means against wear, and provision shall be made for adequate lubrication by readily accessible devices.
- E. All equipment or component of equipment (e.g., motors) greater than 100 pounds shall have lifting lugs, eyebolts, etc., for ease of lifting, without damage or undue stress exerted on its components.
- F. Provide manufacturer's standard materials suitable for service conditions, unless otherwise specified in the individual Specifications.
- G. Where product specifications include a named manufacturer, with or without model number, and also include performance requirements, named manufacturer's products must meet the performance specifications.
- H. Like items of products furnished and installed in the Work shall be end products of one manufacturer and of the same series or family of models to achieve standardization for appearance, operation and maintenance, spare parts and replacement, manufacturer's services, and implement same or similar process instrumentation and control functions in same or similar manner.
- I. Do not use materials and equipment removed from existing premises, except as specifically permitted by Contract Documents.
- J. Provide interchangeable components of the same manufacturer, for similar components, unless otherwise specified.
- K. Equipment, Components, Systems, Subsystems: Design and manufacture with due regard for health and safety of operation, maintenance, and accessibility, durability of

parts, and shall comply with applicable OSHA, state, and local health and safety regulations.

- L. Regulatory Requirement: Coating materials shall meet federal, state, and local requirements limiting the emission of volatile organic compounds and for worker exposure.
- M. Safety Guards: All rotating shafts, couplings, or other moving pieces of equipment shall be provided with suitable protective guards of sheet metal or wire mesh, neatly and rigidly supported. Guards shall be removable as required to provide access for repairs.
- N. Provide materials and equipment listed by UL wherever standards have been established by that agency.

2.02 EQUIPMENT FOUNDATIONS, SUPPORTS AND ANCHORS

- A. The CONTRACTOR shall provide concrete foundations/bases for all equipment items including mechanical equipment, tanks, control cabinets, etc. Concrete foundations shall be provided whether shown on the drawings or not.
- B. Concrete foundations shall be a minimum of 4-inches thick unless otherwise shown or detailed on the Drawings. Equipment bases shall be tied into floor slabs by means of reinforcing bars or dowels. Foundation drawings shall be submitted to the ENGINEER for review in accordance with the requirements of the Section entitled "Submittals".
- C. All equipment supports, anchors, and restrainers shall be adequately designed for static, dynamic, and seismic loads. A seismic force of 0.25 of gravity shall be assumed for this purpose, unless otherwise required by local conditions.
- D. Anchor bolts and fasteners shall be of number, size, strength, and material required for the purpose intended and shall be in accordance with section entitled "Metal Fastening", and with the detailed equipment Specifications. Anchor bolts and templates for equipment foundations shall be furnished by the CONTRACTOR.
- E. Pipe sleeves or other means of adjusting anchor bolts shall be provided where indicated or required. Equipment shall be leveled by first using sitting nuts on the anchor bolts, and then filling the space between the equipment base and concrete pedestal with non-shrink grout, unless alternate methods are recommended by the manufacturer and are acceptable to the ENGINEER (such as shim leveling pumps). Non-shrink grout shall be as specified in section entitled "Grout".

2.03 STANDARDIZATION OF GREASE FITTINGS

- A. The grease fittings on all mechanical equipment shall be such that they can be serviced with a single type of grease gun. Fittings shall be hydraulic type, Alemite.

2.04 ACCESSORIES, LUBRICANTS, SPARE PARTS, AND SPECIAL TOOLS

- A. Spare parts for equipment shall be furnished where indicated in the equipment Specifications or where recommended by the equipment manufacturer.
- B. Spare parts shall be identical and interchangeable with original parts.
- C. Parts shall be supplied in clearly identified containers, except that large or bulky items may be wrapped in polyethylene.
- D. Painting requirements for spare parts shall be identical to those for original, installed parts.
- E. Spare parts shall be stored separately in a locked area, maintained by the CONTRACTOR, and shall be turned over to the OWNER in a group prior to substantial completion. All of these materials shall be properly packed, labeled, and stored where directed by the OWNER and ENGINEER.
- F. CONTRACTOR shall submit, for approval by the ENGINEER, a complete list of the special tools and appliances to be furnished. Such tools and appliances shall be furnished in approved painted steel cases, properly labeled and equipped with good grade cylinder locks and duplicate keys.
- G. The CONTRACTOR shall furnish all special tools and appliances necessary to operate, disassemble, service, repair, and adjust the equipment and shall furnish a one year supply of all recommended lubricating oils and greases. The manufacturer shall submit a list of at least four manufacturer's standard lubricants that may be used interchangeably for each type of lubricant required. All of these materials shall be properly packed, labeled and stored where directed by the ENGINEER.

PART 3 -- EXECUTION

3.01 SHOP TESTING

- A. All equipment so noted in the technical specifications, shall be tested in the shop of the manufacturer in a manner that shall conclusively prove that its characteristics comply fully with the requirements of the Contract Documents and that it will operate in the manner specified or implied.
- B. Where multiple units of an identical design are specified to be tested, unless otherwise noted, only one of each group shall require testing.
- C. Equipment specified to be shop tested shall not be shipped from the manufacturer until the ENGINEER has been furnished a certified copy of test results and has notified the CONTRACTOR, in writing, that the results of such tests are acceptable.
- D. When called for in technical specifications, arrangements shall be made for the ENGINEER and OWNER to witness performance tests in the manufacturer's shop. The

ENGINEER shall be notified ten working days before shop testing commences. Expenses are to be paid by the CONTRACTOR.

- E. Five (5) certified copies of the manufacturer's actual test data and interpreted results thereof, shall be forwarded to the ENGINEER for review.

3.02 DELIVERY, UNLOADING AND INSPECTION

- A. The CONTRACTOR shall not deliver to the job site equipment and materials that are not scheduled to be incorporated into the work within the following 120 calendar days.
- B. Deliver products in accordance with accepted current progress schedule and coordinate to avoid conflict with the Work and conditions at site. Deliver anchor bolts and templates sufficiently early to permit setting prior to placement of structural concrete.
- C. Deliver products in undamaged condition, in manufacturer's original container or packaging, with identifying labels intact and legible. Include on label, date of manufacture and shelf life, where applicable. Include UL labels on products so specified.
- D. Unload products in accordance with manufacturer's instructions for unloading or as specified. Record receipt of products at site. Inspect for completeness and evidence of damage during shipment.
- E. Remove damaged products from site and expedite delivery of identical new undamaged products, and remedy incomplete or lost products to provide that specified, so as not to delay progress of the Work. Delays to the Work resulting from material or equipment damage that necessitates procurement of new products will be considered delays within CONTRACTOR's control.
- F. Notify ENGINEER upon arrival of major equipment and materials.

3.03 HANDLING, STORAGE AND PROTECTION

- A. CONTRACTOR shall store his equipment and materials at the job site in accordance with the requirements of the General Conditions, the Supplemental Conditions, and as hereinafter specified.
- B. All equipment and materials shall be stored in accordance with manufacturer's recommendations and as directed by the OWNER or ENGINEER, and in conformity to applicable statutes, ordinances, regulations and rulings of the public authority having jurisdiction and in manner to prevent damage.
- C. Equipment and materials stored in the job site, or offsite in a bonded warehouse, is stored at the CONTRACTOR's risk. Any equipment or materials of whatever kind, which may have become damaged or deteriorated from any cause, shall be removed and replaced by items that are satisfactory to the ENGINEER at no expense to the OWNER.
- D. Arrange storage in a manner to provide easy access for inspection and manufacturer's

recommended maintenance. Make periodic inspections of stored products to assure that products are maintained under specified conditions, and free from damage or deterioration. Keep running account of products in storage to facilitate inspection and to estimate progress payments for products delivered, but not installed in the Work.

- E. Store electrical, instrumentation, and control products, and equipment with bearings in weather-tight structures maintained above 60 degrees F. Protect electrical, instrumentation, and control products, and insulation against moisture, water, and dust damage.
- F. Where space or strip heaters are provided within the enclosure for motors, valve operators, motor starters, panels, instruments, or other electrical equipment, the CONTRACTOR shall make connections to these heaters from an appropriate power source and operate the heaters continuously with temperature control as necessary until the equipment is installed and being operated according to its intended use.
- G. Store fabricated products above ground on blocking or skids, and prevent soiling or staining. Store loose granular materials in well-drained area on solid surface to prevent mixing with foreign matter. Cover products that are subject to deterioration with impervious sheet coverings; provide adequate ventilation to avoid condensation.
- H. CONTRACTOR shall not store equipment and materials or encroach upon private property without the written consent of the owners of such private property.
- I. CONTRACTOR shall not store unnecessary materials or equipment on the job site.
- J. CONTRACTOR shall take care to prevent any structure from being loaded with a weight which will endanger its security or the safety of persons.
- K. Materials shall not be placed within ten (10) feet of fire hydrants. Gutters, drainage channels and inlets shall be kept unobstructed at all times.
- L. CONTRACTOR shall provide adequate temporary storage buildings/facilities, if required, to protect materials or equipment on the job site.

3.04 INSTALLATION

- A. The CONTRACTOR shall obtain written installation manuals from the equipment manufacturer prior to installation. Equipment shall be installed strictly in accordance with recommendations of the manufacturer. The CONTRACTOR shall retain a copy of the manufacturer's installation manuals on site, stored in the CONTRACTOR's field office and available for review at all times.
- B. The CONTRACTOR shall have on hand sufficient personnel, proper construction equipment, and machinery of ample capacity to facilitate the work and to handle all emergencies normally encountered in work of this character. To minimize field erection problems, mechanical units shall be factory-assembled insofar as practical.

- C. Equipment shall be erected in a neat and workmanlike manner on the foundations at the locations and elevations shown on the Drawings.
- D. All blocking and wedging required for the proper support and leveling of equipment during installation shall be furnished by the CONTRACTOR. All temporary supports shall be removed, except steel wedges and shims, which may be left in place with the approval of the ENGINEER.
- E. When motors are shipped separately and/or with driven equipment, the motors shall be received, properly stored and protected from the environment, meggered once a month and the reports submitted to the ENGINEER. After driven equipment is set, the motors (if shipped separately) shall be set, mounted, shimmed, millrighted, coupled and connected complete.
- F. Space heaters on all stored motors as well as on all motors supplied with equipment shall be continuously energized during storage and after installation, but prior to startup with temporary and/or permanent power as required. External low wattage electric heaters and temporary power, or equivalent, shall be provided for all stored motors not equipped with integral space heaters to satisfy the above requirements.

3.05 CONNECTIONS TO EQUIPMENT

- A. Connections to equipment shall follow manufacturer's recommendations as to size and arrangement of connections and/or as shown in detail on the Drawings or approved Shop Drawings. Piping connections shall be made to permit ready disconnection of equipment with minimum disturbance of adjoining piping and equipment.
- B. The Electrical Contractor or CONTRACTOR if no electrical contract exists shall be responsible for bringing proper electrical service to each item of equipment requiring electrical service as shown on the Drawings or approved Shop Drawings. The Electrical Contractor shall make electrical connections to equipment requiring electrical service, unless otherwise indicated on the Drawings or in the Technical Specifications.
- C. The Electrical Contractor or CONTRACTOR if no electrical contract exists shall be responsible for bringing proper instrumentation/control service to each item of equipment requiring instrumentation/control service as shown on the Drawings or approved Shop Drawings. The Electrical Contractor shall make electrical connections to instrumentation/control equipment requiring electrical service, under the direction of the Instrumentation Subcontractor/supplier unless otherwise indicated on the Drawings or in the Technical Specifications.
- D. The HVAC Contractor or CONTRACTOR if no HVAC Contract exists shall bring and connect HVAC service to all equipment items requiring same as shown on the Drawings. The Electrical Contractor shall make electrical connections to equipment requiring electrical service, unless otherwise indicated on the Drawings or in the Technical Specifications.

- E. The Plumbing Contractor or CONTRACTOR if no plumbing contract exists shall bring and connect plumbing service to all equipment items requiring same as shown on the Drawings.

3.06 FAILURE OF EQUIPMENT TO PERFORM

- A. Any defects in the equipment or failure to meet the guarantees or performance requirements of the Specifications shall be promptly corrected by the CONTRACTOR by replacements or otherwise.
- B. If the CONTRACTOR fails to make these corrections, or if the improved equipment shall fail again to meet the guarantees or specified requirements, the OWNER, notwithstanding his having made partial payment for work and materials which have entered into the manufacture of said equipment, may reject said equipment and order the CONTRACTOR to remove it from the premises at the CONTRACTOR's expense.
- C. The CONTRACTOR shall then obtain specified equipment to meet the contract requirements or upon mutual agreement with the OWNER, adjust the contract price to reflect not supplying the specific equipment item.
- D. In case the OWNER rejects said equipment, then the CONTRACTOR hereby agrees to repay to the OWNER all sums of money paid to him for said rejected equipment on progress certificates or otherwise on account of the lump sum prices herein specified.
- E. Upon receipt of said sums of money, the OWNER will execute and deliver to the CONTRACTOR a bill of sale of all his rights, title, and interest in and to said rejected equipment; provided, however, that said equipment shall not be removed from the premises until the OWNER obtains from other sources other equipment to take the place of that rejected.
- F. Said bill of sale shall not abrogate OWNER's right to recover damages for delays, losses, or other conditions arising out of the basic contract.

3.07 PAINTING

- A. All surface preparation, shop painting, field repairs, finish painting, and other pertinent detailed painting specifications shall conform to applicable sections of Section 09900, Painting.
- B. All inaccessible surfaces of the equipment, which normally require painting, shall be finished painted by the manufacturer. The equipment and motor shall be painted with a high quality epoxy polyamide semi-gloss coating specifically resistant to chemical, solvent, moisture, and acid environmental conditions, unless otherwise specified.
- C. Gears, bearing surfaces, and other unpainted surfaces shall be protected prior to shipment by a heavy covering of rust-preventive compound sprayed or hand applied which shall be maintained until the equipment is placed in operation. This coating shall be easily removable by a solvent.

3.08 WELDING

- A. The Equipment Manufacturer's shop welding procedures, welders, and welding operators shall be qualified and certified in accordance with the requirement of AWS D1.1 "Structural Welding Code - Steel" or AWS D1.2 "Structural Welding Code - Aluminum" of the American Welding Society, as applicable.
- B. The Equipment Manufacturer's shop drawings shall clearly show complete information regarding location, type, size, and length of all welds in accordance with "Standard Welding Symbols" AWS A2.0 of the American Welding Society. Special conditions shall be fully explained by notes and details.
- C. The CONTRACTOR's welding procedures, welders, and welding operators shall be qualified and certified in accordance with the requirements of AWS D1.1 "Structural Welding Code - Steel" or AWS D1.2 "Structural Welding Code - Aluminum" of the American Welding Society, as applicable.
- D. The CONTRACTOR shall perform all field welding in conformance with the information shown on the Equipment Manufacturer's drawings regarding location, type, size, and length of all welds in accordance with "Standard Welding Symbols" AWS A2.0 of the American Welding Society, and special conditions, as shown by notes and details.

3.09 EQUIPMENT IDENTIFICATION

- A. As a minimum, all mechanical, electrical and control system equipment, as well as all valves, gates, manual actuators and motorized actuators shall be provided with a stainless steel nameplate, securely fastened in a conspicuous place, and clearly inscribed with the manufacturer's name, year of manufacture, serial number, and principal rating data.
- B. As a minimum, all mechanical, electrical and control system equipment, as well as all valves, gates, manual actuators and motorized actuators shall also be identified as to equipment tag number, name and description by a suitable stainless steel nameplate attached to the unit; for example, "RWP 11001 Raw Water Pump No. 1". Coordinate name and number with same on remotely located controls, control panel, etc.
- D. Nameplates shall not be painted over.
- E. Refer to Technical Specifications for additional requirements.

- END OF SECTION -

SECTION 01660 - EQUIPMENT TESTING AND STARTUP

PART 1 -- GENERAL

1.01 GENERAL

- A. Equipment testing and startup are requisite to satisfactory completion of the contract and, therefore, shall be completed within the Contract time.
- B. As construction of each system of the project enters the final stages of completion, the CONTRACTOR shall, in accordance with the requirements set forth in the Contract Documents, attend to the following items:
 - 1. Complete all Punch List items required by the ENGINEER prior to startup.
 - 2. Schedule equipment manufacturer's visits to site.
 - 3. Calibration of instruments and controls.
 - 4. Perform required testing adjusting and balancing of project components.
 - 5. Complete all Punch List items that result from testing.
 - 6. Schedule and coordinate training and testing activities.
 - 7. Furnish skilled personnel from manufacturer's and suppliers during training and testing activities.
 - 8. Furnish operation and maintenance training for OWNER's personnel.
 - 9. Successfully demonstrate reliable operation of project systems.

1.02 DEFINITIONS

- A. Facility Startup: Includes putting Project in operating order, cleaning, adjusting and balancing equipment, initial operation (startup) of equipment item, operating equipment, starting systems, operation of systems, testing of equipment and systems, completing required punch list items, and demonstration and verification of the completed facility as a unit.
- B. Functional Test: A test or tests in the presence of the ENGINEER and/or OWNER to demonstrate that the installed equipment or system meets manufacturer's installation and adjustment requirements and other requirements specified including, but not limited to, noise, vibration, alignment, speed, proper operation of electrical, mechanical and information and control equipment, thrust restraint, proper rotation, and initial servicing.
- C. System Performance Test: A test performed in the presence of the ENGINEER and/or OWNER after satisfactory completion of required functional testing, to demonstrate and confirm that the equipment and/or system meet the specified performance requirements for a specified minimum operation period without significant interruption. System performance testing shall not begin until the following are completed:

1. The CONTRACTOR has submitted written test reports, installation reports, and performance affidavits as required in the Contract Documents.
 2. The CONTRACTOR has completed all punch list items.
 3. The CONTRACTOR has completed all functional testing.
- D. Operation Period: The operation period for each system Performance Test shall be 7 consecutive calendar days without significant interruption.
- E. Significant Interruption: May include any of the following events:
1. Failure of CONTRACTOR to maintain qualified onsite startup personnel as scheduled.
 2. Failure to meet specified performance for more than two consecutive hours.
 3. Failure of any critical equipment unit, system, or subsystem that is not satisfactorily corrected within five hours after failure.
 4. Failure of noncritical unit, system, or subsystem that is not satisfactorily corrected within eight hours after failure.
 5. As may be determined by ENGINEER.
- F. System: The overall process, or a portion thereof, that performs a specific function. A system may consist of two or more subsystems as well as two or more types of equipment. The "System" shall be as determined by the ENGINEER.
- G. Training: The services provided by the CONTRACTOR and his equipment supplier to ensure that the OWNER's staff is completely prepared to operate and maintain the contract facilities. Training shall include classroom instruction, as well as "hands-on" field / equipment demonstration, operation, and maintenance. Equipment / contract facilities shall be 100 percent "operational" (as defined by the ENGINEER) during training activities.

1.03 CONTRACTOR'S RESPONSIBILITIES

- A. The CONTRACTOR shall designate and furnish one or more persons to be responsible for coordinating and expediting CONTRACTOR's facility startup, testing, and training duties. The person or persons shall be present during Facility Startup, Functional Testing, and Training meetings and shall be available at all times during the Facility Startup and training period. In addition, the person or persons shall be "on call" (available to assist the OWNER) at all times during the System Performance Testing.
- B. The CONTRACTOR shall provide the services of an experienced and authorized representative of the supplier of each item of equipment (excluding minor items of equipment specifically exempted by the ENGINEER in writing), who shall visit the site of the Work and inspect, check, adjust if necessary, and approve the equipment installation. In each case, the CONTRACTOR shall arrange to have the supplier's representative

revisit the job site as often as necessary until any and all trouble is corrected and the equipment installation and operation are satisfactory to the ENGINEER.

- C. The CONTRACTOR shall require that each supplier's representative furnish to the ENGINEER a written report addressed to the OWNER, and copied to the ENGINEER, certifying that the equipment has been properly installed and lubricated, is in accurate alignment, is free from any undue stress imposed by connecting piping or anchor bolts, has been operated satisfactorily under the complete range of, including but not limited to, full-load, conditions, is ready for operation and the OWNER's operating personnel have been instructed in the operation, maintenance and lubrication of the equipment.
- D. The CONTRACTOR shall furnish all personnel, power, water, chemicals, fuel, oil, grease, and all other necessary equipment, facilities, and services required for conducting the tests.
- E. The CONTRACTOR shall coordinate startup, testing, and training activities with OWNER / ENGINEER in advance and in writing.

1.04 SUBMITTALS

- A. Completed Manufacturer's Certificate of Proper Installation for each equipment item specified for the project. Submit prior to beginning functional testing procedures.
- B. Test Schedules and Test Plans: Eight (8) copies of functional and system performance test schedules and plans for equipment, units, and systems shall be submitted to the ENGINEER, in accordance with the Section entitled "Submittals" at least 30 days prior to start of related testing. Startup shall not commence without prior approval of the test plan. The test plan shall contain the following at a minimum:
 - 1. A schedule of all testing to be conducted.
 - 2. A brief description of the testing to be performed.
 - 3. Testing criteria.
 - 4. Checklists and procedures for performing each test.
 - 5. Sample forms for the collection of test data.
 - 6. Sample test results documentation.
 - 7. Requirements for other parties.
- C. Test Reports: Functional and performance testing reports in a format acceptable to the ENGINEER, shall be furnished in accordance with the Section entitled "Submittals". Test reports shall be submitted prior to project closeout in accordance with the requirements of the Section entitled "Project Closeout".
- D. Training Schedules and Plan: Eight (8) copies of written training schedule and written training plan shall be submitted to the ENGINEER, in accordance with the Section entitled

“Submittals” at least 30 days prior to start of related operation and maintenance training. The training plan shall contain the following at a minimum:

1. A schedule of all training to be conducted. The training schedule shall be adjusted as deemed necessary by the OWNER, to allow full participation by the supplier’s representative, OWNER’s personnel and as needed if the operability of the system being trained on is interrupted for any reason. This may require training during three separate shifts.
 2. A brief description of the training to be performed.
 3. Sample training materials and handouts.
 4. Qualifications of the supplier's representative performing the training.
 5. Training agenda for each major equipment item shall be prepared. As a minimum, the agenda shall include but not limit to the following items:
 - a. General description of the equipment item
 - b. Start-up procedure
 - c. Shutdown procedure
 - d. Operation and control description
 - e. Adjustment and trouble-shooting
 - f. Maintenance
- E. Written Notification: Any CONTRACTOR activity that may impact operation of existing facilities shall be confirmed in writing at least 48 hours in advance of initiation of that activity. This requirement is in addition to the 30-day advance submittal of plans to more clearly confirm coordination efforts required. This notification shall include, as minimum:
1. Scheduled date and time (start, finish, duration) of CONTRACTOR’s activity.
 2. Brief description of activity.
 3. Brief description of any OWNER activity that is required to coordination with CONTRACTOR’s activity (such as shutdown of a unit process or system, power supply, etc.).

PART 2 – PRODUCTS (NOT USED)

PART 3 -- EXECUTION

3.01 PREPARATION FOR EQUIPMENT FUNCTIONAL TESTING

- A. The following shall be completed prior to the CONTRACTOR initiating the Functional Testing:

1. Conduct (or have previously conducted, whichever is appropriate) all field inspections and tests as defined in the individual specification sections, installation checks, disinfection, hydrostatic tests, other preliminary or initial tests, and necessary corrections required, to demonstrate that individual components of the Work have been properly erected and found to operate in accordance with the Contract Documents, so that they can be utilized for their intended purposes.
2. Remove all electrical jumpers, bypasses or other items connected to the equipment which are not intended to remain in the facility and are not required by the specifications. Demonstrate that each component is operating under its own control as designated.
3. Confirm that all electrical circuits are energized in the automatic position, that valves and gates are set to their normal position and that the flow path through the Work is unobstructed.
4. All identification tagging and pipe identification shall be complete prior to initiation of functional testing.
5. All spare parts and special tools shall be delivered to OWNER prior to initiation of function testing.
6. Notification by CONTRACTOR of equipment readiness for testing.
7. Acceptable testing plan.
8. Acceptable Operation and Maintenance Manuals.
9. Receipt of Manufacturer's Certificate of Proper Installation.
10. Adequate completion of Work adjacent to, or interfacing with, equipment to be tested.
11. Availability and acceptability of manufacturer's representative, when specified, to assist in testing of respective equipment.
12. Satisfactory fulfillment of other specified manufacturers' responsibilities.

3.02 FUNCTIONAL TESTING

A. General:

1. Begin testing at a time mutually agreed upon by the OWNER and/or ENGINEER, manufacturer's representative(s), and CONTRACTOR.
2. Notify in writing OWNER, ENGINEER, and manufacturer's representative at least 14 days prior to scheduled date of functional tests.
3. Separate items of equipment demonstrated to function properly during subsystem testing may require no further functional test if documentation of subsystem testing is acceptable to ENGINEER.

4. Conduct functional test until each individual component item or system has achieved a minimum of 2 continuous hours of satisfactory operation; unless a longer length of time is specified elsewhere in the Technical Specifications for specific equipment items. The longer period of time shall apply. Demonstrate all operational features and controls function during this period while in automatic modes.
5. If, in ENGINEER's opinion, each system meets the functional requirements specified, such system will be accepted as conforming for purposes of advancing to performance testing phase, if required. Complete and initial appropriate section of the Manufacturer's Certificate of Proper Installation. This Certificate shall be retained by the ENGINEER.
6. If, in ENGINEER's opinion, functional test results do not meet requirements specified, the systems will be considered as nonconforming.

3.03 SYSTEM PERFORMANCE TESTING

A. General:

1. The startup of each facility and performance testing is a highly complex operation requiring the combined technical expertise of the CONTRACTOR, suppliers, subcontractors, the ENGINEER, and the OWNER. The CONTRACTOR shall provide the effective and advance coordination of all parties necessary for the successful startup.
2. System performance testing shall not commence until Punch List items are adequately addressed to the ENGINEER's satisfaction, and the equipment or system meets functional tests specified.
3. All defects in materials or workmanship that appear during the system performance test shall be immediately corrected by the CONTRACTOR. Time lost for equipment repairs, wiring corrections, control point settings, or other reasons which actually interrupt the startup may, at the discretion of the ENGINEER, be justifiable cause for extending the system performance test Operation Period.
4. Should a significant interruption as defined previously in this Section be incurred, the test shall be restarted from the beginning, unless the failure is of two hours or less in duration or considered minor by the ENGINEER. The CONTRACTOR shall bear all costs associated with restarting the test period. Restart of the test period shall be solely at the ENGINEER's discretion.

B. System Performance Testing:

1. The duration of the system performance test shall be as defined in Article 1.02 of this Section, or as defined elsewhere in the Documents, whichever is longer.
2. The CONTRACTOR shall provide technical representatives of all equipment manufacturers, system suppliers, subcontractors, etc. for as-needed service to address mechanical malfunctions.

3. The CONTRACTOR shall furnish and coordinate the services of technical representatives of all equipment manufacturers to perform the testing services outlined in Contract Documents and the testing plan. The technical representatives of all equipment manufacturers shall perform startup testing and prepare test reports.
4. During the System Performance Testing, the CONTRACTOR shall assist the OWNER in directing the OWNER's personnel performing routine operating functions for the new facility.
5. The CONTRACTOR shall also be responsible for furnishing mechanics, labor, materials, and equipment that may be required to repair any malfunctions to equipment furnished and installed under the scope of this project.
6. Upon successful completion of the performance test complete, date and initial the appropriate section of the Manufacturer's Certificate of Proper Installation. This form shall be retained by the ENGINEER.

3.04 O&M TRAINING

- A. The training period shall not begin until successful completion of all system Functional Testing. The training period may be concurrent with the Performance Testing period; however, shall not be deemed complete, or shall be considered interrupted if there is a Significant Interruption of the Performance Testing. If a Significant Interruption occurs, training shall be repeated and/or continued at the OWNER's option, at the time that the Performance Testing restarts. Also, training shall not begin until all O&M Manuals, specified in the Section entitled "Submittals", have been accepted by the ENGINEER.
- B. During the training period the CONTRACTOR shall provide the services of an experienced representative of the supplier of each item of equipment (excluding minor items of equipment specifically exempted by the ENGINEER in writing), who shall visit the site and instruct the OWNER's operating and maintenance personnel in correct operation and maintenance procedures. It is noted that training requirements are specified throughout the Contract Documents. The instruction shall demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment. Training shall include classroom and field / hands-on (with operational equipment) instruction. Training shall be provided only while the respective representative's equipment is fully operational. On-site instruction shall be given by qualified persons who have been made familiar in advance with the equipment and systems at the project site.
- C. Training shall be scheduled and coordinated by the CONTRACTOR. Training hours shall be arranged in writing with the OWNER at least 14 days in advance of the scheduled training with a subsequent written confirmation at least 48 hours in advance.

- END OF SECTION -

MANUFACTURER'S CERTIFICATE OF PROPER INSTALLATION

TO ENGINEER: _____

PROJECT: _____ PROJECT NO: _____

OWNER: _____

EQPT/SYSTEM: _____ SPEC SECTION: _____

EQPT SERIAL NO: _____ EQPT TAG NO: _____

I hereby certify that the above-referenced equipment/system has been:

PROPER INSTALLATION CHECKLIST:

Installed in accordance with Manufacturer's recommendations.

- * Inspected, checked, and adjusted.
- * Serviced with proper initial lubricants.
- * Electrical and mechanical connections meet quality and safety standards.
- * All applicable safety equipment has been properly installed.

FUNCTIONAL TEST CHECKLIST:

- * Has been functionally tested and meets specified requirements.

Functional Test Date: _____ Start Time: _____ End Time: _____

PERFORMANCE TEST CHECKLIST:

- * Has been performance tested, meets specified requirements, and is ready for startup.

Performance Test Start Date: _____ End Date: _____

NOTE: Attach functional test and performance test documentation from manufacturer.

Comments:

I, the undersigned Manufacturer's Representative, hereby certify that I am (i) a duly authorized representative of the manufacturer, (ii) empowered by the manufacturer to inspect, and operate his equipment and (iii) authorized to make recommendations required to assure that the equipment furnished by the manufacturer is complete and operational, except as may be otherwise indicated herein. I further certify that all information contained herein is true and accurate.

Date: _____, 20 ____

Manufacturer: _____

By Manufacturer's Authorized Representative: _____

Authorized Signature

SECTION 01700 - PROJECT CLOSEOUT

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Final Cleaning

1. At the completion of the work, the CONTRACTOR shall remove all rubbish from and about the site of the work, and all temporary structures, construction signs, tools, scaffolding, materials, supplies and equipment which he or any of his Subcontractors may have used in the performance of the work. CONTRACTOR shall broom clean paved surfaces and rake clean other surfaces of grounds.
2. CONTRACTOR shall thoroughly clean all materials, equipment and structures; all marred surfaces shall be touched up to match adjacent surfaces; dirty filters and burned out lights replaced as required; all glass surfaces cleaned and floors cleaned and polished so as to leave work in a clean and new appearing condition.
3. CONTRACTOR shall maintain cleaning until project, or portion thereof, is occupied by the OWNER.

B. Lubrication Survey

1. A lubrication survey, made by a lubricant supply firm, subject to the approval of the OWNER shall be provided and paid for by the CONTRACTOR.
2. The lubrication survey shall list all equipment, the equipment manufacturer's lubrication recommendations, and an interchangeable lubricants tabulation standardizing and consolidating lubricants whenever possible.
3. The CONTRACTOR shall supply all lubricants, applicators and labor for lubricating the equipment, in accordance with manufacturer's recommendations, for field testing and prior to final acceptance. A supply of required lubricants sufficient for start-up and one year of operation shall also be supplied by the CONTRACTOR.
4. Ten (10) copies of the approved lubrication survey shall be furnished to the ENGINEER prior to final acceptance.

C. Spare Parts and Special Tools

1. As soon as practicable after approval of the list of equipment, the CONTRACTOR shall furnish spare parts data for each different item of equipment listed. The data shall include a complete list of parts and supplies, with current unit prices and source or sources of supply.

2. CONTRACTOR shall also furnish a list of parts, and supplies that are either normally furnished at no extra cost with the purchase of the equipment or specified to be furnished as part of the Contract and a list of additional items recommended by the manufacturer to assure efficient operation for a period of one-hundred and twenty (120) days for the particular installation.
3. All parts shall be securely boxed and tagged, and clearly marked on the box and individually for identification as to the name of manufacturer or supplier, applicable equipment, part number, description and location in the equipment. All parts shall be protected and packaged for a shelf life of at least ten (10) years.
4. Unless otherwise specified in the Contract Documents, the CONTRACTOR shall, as a minimum, furnish at no additional cost to the OWNER with each piece of equipment, one (1) complete set, or the number of sets called for in the Technical Specifications (whichever is greater), of suitably marked special tools and appliances which may be needed to adjust, operate, maintain, or repair the equipment.
5. The CONTRACTOR shall submit, for approval by the ENGINEER, a complete list of the special tools and appliances to be furnished. Such tools and appliances shall be furnished in approved painted steel cases properly labeled and equipped with good grade cylinder locks and duplicate keys.

D. Equipment Start-Up Services

1. Equipment start-up period, for the training of plant personnel, shall begin after satisfactory completion and acceptance of the field tests and coincidentally with the certified date of substantial completion for the part of the work for which the equipment is included. If the equipment is not covered by a certificate of substantial completion for a part of the work, the period shall begin upon substantial completion of the project.
2. During the equipment start-up period the CONTRACTOR shall furnish, at no additional cost to the OWNER the services of factory trained representatives of the equipment manufacturers for the equipment designated in the Specifications to:
 - a. Assist in the start-up and operations of the equipment.
 - b. Assist in the training of plant personnel, designated by the OWNER in the proper operation and maintenance of the equipment.
3. The OWNER shall:
 - a. Provide the necessary plant personnel to be instructed in the operation and maintenance of the equipment. The OWNER's personnel shall operate all equipment.

- b. Pay for all fuel, power and chemicals consumed beyond quantities specified in the Contract Documents. The CONTRACTOR shall pay for fuel, power, and chemicals consumed up to the date of "certified substantial completion" except as otherwise specified herein.
4. CONTRACTOR shall be available to promptly repair all work during the start-up period so as to cause minimum disruption to the total plant operation.
5. Upon completion of a minimum of ten (10) consecutive and continuous days of satisfactory operation, or the number of days called for in the Technical Specifications, the OWNER will assume operation and operating cost of the equipment. If the equipment malfunctions during this start-up period, the start-up period will be repeated until satisfactory operation is achieved.
6. In the event a system, equipment or component proves defective or is unable to meet specified performance criteria, the CONTRACTOR shall replace the defective item and the minimum one (1) year guarantee period, or the guarantee period called for in the Technical Specifications shall start after satisfactory replacement, testing and acceptance of the item along with the completion of all other pre-requisites as required by the Contract Documents.

E. Final Cleanup; Site Rehabilitation

1. Before finally leaving the site, the CONTRACTOR shall wash and clean all exposed surfaces which have become soiled or marked, and shall remove from the site of work all accumulated debris and surplus materials of any kind which result from his operation, including construction equipment, tools, sheds, sanitary enclosures, etc. The CONTRACTOR shall leave all equipment, fixtures, and work, which he has installed, in a clean condition. The completed project shall be turned over to the OWNER in a neat and orderly condition.
2. The site of the work shall be rehabilitated or developed in accordance with other sections of the Specifications and the Drawings. In the absence of any portion of these requirements, the CONTRACTOR shall completely rehabilitate the site to a condition and appearance equal or superior to that which existed just prior to construction, except for those items whose permanent removal or relocation was required in the Contract Documents or ordered by the OWNER.

F. Final Inspection

1. Final cleaning and repairing shall be so arranged as to be finished upon completion of the construction work. The CONTRACTOR will make his final cleaning and repairing, and any portion of the work finally inspected and accepted by the ENGINEER shall be kept clean by the CONTRACTOR, until the final acceptance of the entire work.
2. When the CONTRACTOR has finally cleaned and repaired the whole or any portion of the work, he shall notify the ENGINEER that he is ready for final

inspection of the whole or a portion of the work, and the ENGINEER will thereupon inspect the work. If the work is not found satisfactory, the ENGINEER will order further cleaning, repairs, or replacement.

3. When such further cleaning or repairing is completed, the ENGINEER, upon further notice, will again inspect the work. The "Final Payment" will not be processed until the CONTRACTOR has complied with the requirements set forth, and the ENGINEER has made his final inspection of the entire work and is satisfied that the entire work is properly and satisfactorily constructed in accordance with the requirements of the Contract Documents.

G. Project Close Out

1. As construction of the project enters the final stages of completion, the CONTRACTOR shall, in concert with accomplishing the requirements set forth in the Contract Documents, attend to or have already completed the following items as they apply to his contract:
 - a. Scheduling equipment manufacturers' visits to site.
 - b. Required testing of project components.
 - c. Scheduling start-up and initial operation.
 - d. Scheduling and furnishing skilled personnel during initial operation.
 - e. Correcting or replacing defective work, including completion of items previously overlooked or work which remains incomplete, all as evidenced by the ENGINEER's "Punch" Lists.
 - f. Attend to any other items listed herein or brought to the CONTRACTOR's attention by the ENGINEER.
2. Just before the ENGINEER's Certificate of Substantial Completion is issued, the CONTRACTOR shall accomplish the cleaning and final adjustment of the various building components as specified in the Specifications and as follows:
 - a. Clean all glass and adjust all windows and doors for proper operation.
 - b. Clean all finish hardware after adjustment for proper operation.
 - c. Touch up marks or defects in painted surfaces and touch up any similar defects in factory finished surfaces.
 - d. Wax all resilient flooring materials.
 - e. Remove bitumen from gravel stops, fascias, and other exposed surfaces.

- f. Remove all stains, marks, fingerprints, soil, spots, and blemishes from all finished surfaces, tile, stone, brick, and similar surfaces.
- 3. In addition, and before the Certificate of Substantial Completion is issued, the CONTRACTOR shall submit to the ENGINEER (or to the OWNER if indicated) certain records, certifications, etc., which are specified elsewhere in the Contract Documents. A partial list of such items appears below, but it shall be the CONTRACTOR's responsibility to submit any other items which are required in the Contract Documents:
 - a. Test results of project components.
 - b. Performance Affidavits for equipment.
 - c. Certification of equipment or materials in compliance with Contract Documents.
 - d. Operation and maintenance instructions or manuals for equipment.
 - e. One set of neatly marked-up record drawings showing as-built changes and additions to the work under his Contract.
 - f. Any special guarantees or bonds (Submit to OWNER).
- 4. The CONTRACTOR's attention is directed to the fact that required certifications and information under Item 3 above, must actually be submitted earlier in accordance with other Sections of the Specifications.

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

SECTION 02100 - TEMPORARY EROSION AND SEDIMENTATION CONTROL

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall design, provide, maintain and remove temporary erosion and sedimentation controls as necessary.
- B. Temporary erosion controls may include, but are not limited to, mulching, netting, and watering, on site surfaces and spoil and borrow are surfaces and providing interceptor ditches at ends of berms and at those locations which will ensure that erosion during construction will be either eliminated or maintained within acceptable limits as established by the Owner.
- C. Temporary sedimentation controls include, but are not limited to: silt dams, traps, barriers and appurtenances at the foot of sloped surfaces which will ensure that sedimentation pollution will be either eliminated or maintained within acceptable limits as established by the Owner.
- D. Contractor shall provide effective temporary erosion and sediment control measures during construction or until final controls become effective.
- E. The CONTRACTOR is responsible for obtaining permits required by the National Pollutant Discharge Elimination System (NPDES) Stormwater Permitting program for construction activity, as required by Florida Administrative Code (F.A.C.) Chapter 62-621 and administered by the Florida Department of Environmental Protection (FDEP).
- F. The CONTRACTOR shall be responsible for implementation, maintenance and inspection of stormwater pollution prevention control measures in accordance with F.A.C. Chapter 62-621 including, but not limited to, erosion and sediment control, stormwater management plans, waste collection and disposal, off-site vehicle tracking, and other practices specified herein or required by permitting agencies. The stormwater pollution prevention control measures shall include protection of offsite public and private storm sewer facilities potentially impacted during construction. Stormwater facilities include streets, inlets, pipes, ditches, swales, canals, culverts, control structures, and detention/retention areas.
- G. The CONTRACTOR shall prepare and submit to permitting agencies with jurisdiction a Stormwater Pollution Prevention Plan (SWPPP) when required by FDEP.

1.02 REFERENCE DOCUMENTS

- A. "Guidelines for Erosion and Sediment Control, Planning and Implementation" and "Processes, Procedures and Methods to Control Pollution Resulting from all Construction Activity", published by the United States Environmental Protection Agency.

1.03 SUBMITTALS

- A. Submit a copy of the approved SWPPP for temporary erosion and sedimentation control.

PART 2 -- PRODUCTS

2.01 EROSION CONTROL

- A. Seeding and mulching, fertilization and watering shall be in accordance with Section 570-1 through 570-3 of the FDOT Specifications.
- B. Netting: Fabricated of material acceptable to the Owner.

2.02 SEDIMENTATION CONTROL

- A. Bales: Clean, seed free cereal hay type.
- B. Netting: Fabricated of material acceptable to the Owner.
- C. Filter Stone: Crushed stone conforming to FDOT Specifications.

PART 3 -- EXECUTION

3.01 EROSION CONTROL

- A. Seeding shall be in accordance with Section 570-4 through 570-5 of the FDOT Specifications. The Contractor shall ensure that all seeded areas have sustained growth prior to acceptance.
- B. Mulching shall be in accordance with Section 570-4.6 of the FDOT Specifications.
- C. Minimum procedures for mulching and netting are:
 - 1. Apply mulch loosely to a thickness of between 0.75 inches and 1.5 inches.
 - 2. Apply netting over mulched areas on sloped surfaces.

3.02 SEDIMENTATION CONTROL

- A. Install and maintain silt dams, traps and barriers as shown on the approved schedule. Hay bales which deteriorate and filter stone which is lodged shall be replaced as required.

3.03 PERFORMANCE

- A. Should any of the temporary erosion and sediment control measures employed by the Contractor fail to produce results which comply with the requirements of the Owner, Contractor shall immediately take whatever steps are necessary to correct the deficiency at his own expense.

3.04 CLEANING OF EXISTING DRAINAGE STRUCTURES

- A. All existing drainage catch basins and manholes within the project area shall be cleaned of debris and maintained debris free throughout the construction period.

- END OF SECTION –

SECTION 02222 - EXCAVATION AND BACKFILL FOR UTILITIES

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. Excavate, grade and backfill as required for underground piping systems and appurtenances as shown on the Drawings and specified herein.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Codes: All codes, as referenced herein, are specified in Section entitled "Reference Standards".
- B. Commercial Standards:
 - ASTM D 422 Method for Particle-Size Analysis of Soils.
 - ASTM D 698 Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5-lb (2.49-kg) Rammer and 12-in (304.8-mm) Drop.
 - ASTM D 1556 Test Method for Density of Soil in Place by the Sand-Cone Method.
 - ASTM D 1557 Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb (4.54-kg) Rammer and 18-in (457-mm) Drop.
 - ASTM D 2419 Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
 - ASTM D6938 Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

1.03 SUBMITTALS

- A. General: Submit information and samples to the Engineer for review as specified herein in accordance with Section entitled "Submittals".
- B. Dewatering: The Contractor shall submit to the Engineer its proposed methods of handling trench water and the locations at which the water will be disposed of. Methods shall be acceptable to the Engineer before starting the excavation.
- C. Bedding and Backfill Materials: The Contractor shall notify the Engineer of the off-site sources of bedding and backfill materials, and submit to the Engineer a representative sample weighing approximately 50 lbs. The sample shall be delivered to a location on site determined by the Engineer.
- D. Sheeting System: Drawings of the sheeting system and design computations shall be submitted to the Engineer; however, the review of these drawings shall in no way relieve the Contractor of the responsibility to provide a safe and satisfactory sheeting and shoring system. Sheeting and shoring shall be designed by the Contractor, and the proposed design shall be sealed by a Professional Engineer registered in the State of Florida. If the Engineer is of the opinion that at any point sufficient or proper supports have not been provided, it may order additional supports put in at the Contractor's expense.

- E. Dewatering Permits: If the quantity or nature of water withdrawn requires approval/permits from regulatory agencies, the Contractor shall procure such permits at its expense and submit copies to the Engineer before commencing the work.

1.04 QUALITY CONTROL

- A. An independent testing laboratory will be retained by the Owner to do appropriate testing as described in the Section entitled "Testing and Inspection". The Contractor shall schedule its work so as to permit a reasonable time for testing before placing succeeding lifts and shall keep the laboratory informed of its progress. A minimum of 48 hours of notice shall be provided to the testing laboratory to mobilize its activities.

1.05 SUBSURFACE INFORMATION

- A. The Contractor shall be responsible for anticipating groundwater conditions and shall provide positive control measures as required. Such measures shall ensure stability of excavations, groundwater pressure control, prevention of tanks, pipes, and other structures from being lifted by hydrostatic pressures, and avoiding the disturbance of subgrade bearing materials.

1.06 TRENCH SAFETY ACT COMPLIANCE

- A. The Contractor by signing and executing the contract is, in writing, assuring that it will perform any trench excavation in accordance with the Florida Trench Safety Act, Section 553.60 et. seq.. The Contractor has further identified the separate item(s) of cost of compliance with the applicable trench safety standards as well as the method of compliance as noted in the "Bid Forms" Section of the Contract front-end documents.
- B. The Contractor acknowledges that this cost is included in the applicable items of the Proposal and Contract and in the Grand Total Bid and Contract Price.
- C. The Contractor is, and the Owner and Engineer are not, responsible to review or assess the Contractor's safety precautions, programs or costs, or the means, methods, techniques or technique adequacy, reasonableness of cost, sequences or procedures of any safety precaution, program or cost, including but not limited to, compliance with any and all requirements of Florida Statute Section 553.60 et. seq. cited as the "Trench Safety Act". The Contractor is, and the Owner and Engineer are not, responsible to determine if any safety or safety related standards apply to the project, including but not limited to, the "Trench Safety Act".

1.07 PROTECTION OF PROPERTY AND STRUCTURES

- A. The Contractor shall, at its own expense, sustain in place and protect from direct or indirect injury, all pipes, poles, conduits, walls, buildings, and all other structures, utilities, and property in the vicinity of its Work. Such sustaining shall be done by the Contractor. The Contractor shall take all risks attending the presence or proximity of pipes, poles, conduits, walls, buildings, and all other structures, utilities, and its Work. It shall be responsible for all damage, and assume all expenses, for direct or indirect injury and damage, caused by its Work, to any such pipe, structures, etc., or to any person or property, by reason of injury to them, whether or not such structures, etc., are shown on the Drawings.
- B. Barriers shall be placed at each end of all excavations and at such places as may be necessary along excavations to warn all pedestrian and vehicular traffic of such excavations. Barricades with flashing lights shall also be placed along excavation from sunset each day to sunrise of the next day until such excavation is entirely refilled, compacted, and paved. All excavations shall be barricaded where required to meet

OSHA, local and Federal Code requirements, in such a manner to prevent persons from falling or walking into any excavation within the site fenced property limits.

PART 2 - PRODUCTS

2.01 BEDDING MATERIAL

- A. Bedding materials shall be furnished from acceptable off-site sources. The Contractor shall notify the Engineer of the sources of each material at least ten calendar days prior to the anticipated use of the materials.
- B. Screened gravel shall be used as bedding material for small diameter pipe (less than 24 inches). Screened gravel shall also be used as bedding material for fiberglass, PVC, HDPE or other plastic pipe when installation is in the wet. Screened gravel shall consist of hard, durable particles of proper size and graduation, and shall be free from organic material, wood, trash, sand, loam, clay, excess fines, and other deleterious materials. The gravel shall be graded within the following limits:

<u>Sieve Size</u>	<u>Percent Finer by Weight</u>
1 inch	100
3/4 inch	99
1/2 inch	65
No. 4	2

- C. Crushed stone shall be used for bedding of 24 inch and larger diameter pipe. Crushed stone shall also be used when the trench is within the water table for all types of piping except fiberglass, PVC, HDPE or other plastic pipe. Crushed stone shall consist of hard, durable, subangular particles of proper size and gradation, without clay, fines, and other deleterious materials. The stone shall be graded within the following limits:

<u>Sieve Size</u>	<u>Percent Finer by Weight</u>
5/8 inch	100
1/2 inch	40 – 100
3/8 inch	15 – 45
No. 10	0 – 5

- D. Sand shall be used for bedding polyvinyl chloride, fiberglass, HDPE and other plastic pipe when installed under dry trench conditions. Sand shall be graded sand with 100 percent passing a 3/8-inch sieve and not more than 5 percent passing a No. 200 sieve.

2.02 SELECT BACKFILL

- A. Select Backfill: Select backfill shall be clean sandy material passing through a 3/4-inch sieve as select backfill material.
- B. Any excess structural fill shall be disposed of off-site by the Contractor.

2.03 GENERAL BACKFILL

- A. All other backfill (general backfill) placed above the select backfill shall pass through a 6-inch ring. General backfill shall contain no more than 10 percent organics. General backfill

used under roadways shall be compatible with the materials and compaction specified under the corresponding pavement specifications in this Project.

PART 3 - EXECUTION

3.01 EXCAVATION

- A. The Contractor shall perform all excavation of every description and of whatever substance encountered, to the dimensions, grades and depths shown on the Drawings, or as required for a proper installation. All excavations shall be made by open cut and in accordance with the Trench Safety Act. All existing utilities such as pipes, poles and structures shall be carefully located, supported and protected from injury; in case of damage, they shall be restored at the Contractor's expense.
- B. Pipe trenches for piping shall be excavated to a width within the limits of the top of the pipe and the trench bottom so as to provide a clearance on each side of the pipe barrel, measured to the face of the excavation, or sheeting if used, of 8 inches to 18 inches. Where the pipe size exceeds 12 inches, the clearance shall be from 12 inches to 18 inches. All pipe trenches shall be excavated to a level where suitable material is reached, a minimum of 8 inches below the pipe barrel or that will allow for a minimum of 36 inches of covering unless otherwise indicated on the Drawings.
- C. Ladders or steps shall be provided for and used by workmen to enter and leave trenches.
- D. Excavated unsuitable material shall be removed from the site and disposed of by the Contractor. Materials removed from the trenches shall be stored and in such a manner that will not interfere unduly with traffic on public roadways and sidewalks and shall not be placed on private property. In congested areas, such materials that cannot be stored adjacent to the trench or used immediately as backfill shall be removed to other convenient places of storage acceptable to the Owner at the Contractor's expense.
- E. Excavated material that is suitable for use as backfill shall be used in areas where sufficient material is not available from the excavation. Suitable material in excess of backfill requirements shall be disposed off-site at the Contractor's expense.

3.02 SHEETING AND BRACING

- A. The Contractor shall furnish, place and maintain sheeting and bracing to support sides of the excavation as necessary to provide safe working conditions in accordance with OSHA requirements, and to protect pipes, structures and other Work from possible damage. Where wood sheeting or certain designs of steel sheeting are used, the sheeting shall be cut off at a level of 2 feet above the top of the installed pipe and that portion below the level shall be left in place. If interlocking steel sheeting is used, it may be removed providing removal can be accomplished without disturbing the bedding, pipe or alignment of the pipe. Any damage to the pipe bedding, pipe or alignment of the constructed utility caused by the removal of sheeting shall be cause for rejection of the affected portion of the work. The Owner may permit sheeting to be left in place at the request and expense of the Contractor or the Owner may order it in writing to leave in place, for the prevention of damage to structures or property. Payment for sheeting ordered to remain in place shall be paid for at a negotiated price.
- B. If the Engineer is of the opinion that at any point sufficient or proper supports, have not been provided, it may order additional supports put in at the Contractor's expense. The Contractor shall be responsible for the adequacy of all sheeting used and for all damage resulting from sheeting and bracing failure or from placing, maintaining and removing it.

3.03 REMOVAL OF WATER

- A. General: It is a basic requirement of these Specifications that excavations shall be free from water before pipe or structures are installed.
- B. The Contractor shall provide pumps, and other appurtenant equipment necessary to remove and maintain water at such a level as to permit construction in a dry condition. The Contractor shall continue dewatering operations until backfilling has progressed to a sufficient depth over the pipe to prevent flotation or movement of the pipe in the trench or so that it is above the water table. If at any point during the dewatering operation it is determined that fine material is being removed from the excavation sidewalls, the dewatering operation shall be stopped. If any of the subgrade or underlying material is disturbed by movement of groundwater, surface water, or any other reason, it shall be replaced at the Contractor's expense with crushed stone or gravel.
- C. The Contractor shall use dewatering systems that include automatic starting devices, and standby pumps that will ensure continuous dewatering in the event of an outage of one or more pumps.
- D. Disposal: Water from the trenches and excavation shall be disposed of in such a manner as will not cause injury to public health, to public or private property, to the Work completed or in progress, to the surface of the streets, cause any interference with the use of the same by the public, or cause pollution of any waterway or stream. The Contractor shall submit its proposed methods of handling trench water and locations at which the water will be disposed of to the Engineer for review and shall receive acceptance before starting the excavation. Disposal to any surface water body will require silt screens to prevent any degradation in the water body. The Contractor shall have responsibility for acquiring all necessary jurisdictional permits for disposal.

3.04 TRENCH STABILIZATION

- A. No claims or additional payment will be considered for cost incurred in the stabilization of trench bottoms which are rendered soft or unstable as a result of construction methods, such as improper or inadequate sheeting, dewatering or other causes. In no event shall pipe be installed when such conditions exist and the Contractor shall correct such conditions so as to provide proper bedding or foundations for the proposed installation at no additional cost to the Owner before placing the pipe or structures.

3.05 PIPE BEDDING IN DRY TRENCHES

- A. Pipe trenches shall be excavated as described in Article 3.01. The resulting excavation shall be backfilled with acceptable pipe bedding material, up to the level of the centerline of the proposed pipe barrel. This backfill shall be tamped and compacted to provide a proper bedding for the pipe and shall then be shaped to receive the pipe. Bedding shall be provided under the branch of all fittings to furnish adequate support and bearing under the fitting.
- B. Any over excavation below the levels required for installation of the pipe shall be backfilled with acceptable bedding material, tamped, compacted and shaped to provide proper support for the proposed pipe, at the Contractor's expense.

3.06 BACKFILL

- A. The Contractor shall not backfill trenches until the piping has been inspected and tested in accordance with the Section entitled "Pipeline Testing".

- B. Pipelines: Pipeline trenches shall be backfilled to a level 12 inches above the top of the pipe with select backfill. When placed in the dry, such material shall be placed in 9-inch layers. Only hand operated mechanical compacting equipment shall be used within six inches of the installed pipe.
- C. After the select backfill has been placed as specified above, and after all excess water has completely drained from the trench, general backfilling of the remainder of the trench may proceed. General backfill shall be placed in horizontal layers, the depth of which shall not exceed the ability of the compaction equipment employed, and in no event shall exceed a depth of 12 inches. Each layer shall be moistened, tamped, puddled, rolled or compacted.
- D. Manholes and Vaults: Any excavation below the levels required for the proper construction of manholes or vaults shall be filled with Class B concrete. The use of earth, rock, sand or other materials for this purpose will not be permitted.

3.07 COMPACTION AND DENSITIES

- A. Compaction of backfill shall be 98 percent of the maximum density where the trench is located under structures or paved areas, and 95 percent of the maximum density elsewhere. Methods of control and testing of backfill construction are:
 - 1. Maximum density of the material in trenches shall be determined by ASTM D 1557.
 - 2. Field density of the backfill material in place shall be determined by ASTM D 1556 or D 2922.
- B. Testing: Laboratory and field density tests, which in the opinion of the Engineer are necessary to establish compliance with the compaction requirements of these Specifications, shall be ordered by the Engineer. The Contractor shall coordinate and cooperate with the testing laboratory. The testing program will be implemented by the Engineer establishing depths and locations of tests. Modifications to the program will be made as job conditions change.
- C. Trench backfill which does not comply with the specified densities, as indicated by such tests, shall be reworked and recompacted until the required compaction is secured, at no additional cost to the Owner. The costs for retesting such Work shall be paid for by the Contractor.

3.08 ADDITIONAL EXCAVATION AND BACKFILL

- A. Where organic material, such as roots, muck, or other vegetable matter, or other material which, in the opinion of the Engineer, will result in unsatisfactory foundation conditions, is encountered below the level of the proposed pipe bedding material, it shall be removed to a depth of two feet below the outside bottom of the pipe or to a greater depths as directed by the Engineer and removed from the site. Sheet piling shall be installed if necessary to maintain pipe trenches within the limits identified by the Engineer. The resulting excavation shall be backfilled with suitable backfill material, placed in 12-inch layers, tamped and compacted up to the level of the bottom of the proposed pipe bedding material. Sufficient compaction of this material shall be performed to protect the proposed pipe against settlement. Lean concrete may be used in lieu of backfill when pipe installation is in the wet or at the Contractor's option.
- B. Additional excavation (more than two feet below the pipe or foundation slab) shall be performed when ordered by the Engineer. Where organic or other material is encountered in the excavation, the Contractor shall bring the condition to the attention of the Engineer

and obtain its determination as to whether or not the material will require removal, prior to preparing the pipe bedding. The excavation of material up to a depth of two feet below the outside bottom incidental items of construction and the Work shall be done at no additional cost to the Owner. Where ordered by the Engineer, excavation greater than two feet below the pipe, backfill and additional sheeting, will be compensated by the Owner.

3.09 RESTORATION OF EXISTING SURFACES

- A. Restore all grassed areas disturbed by the trenching operations by re-sodding.

- END OF SECTION -

SECTION 02224 - EXCAVATION AND BACKFILL FOR STRUCTURES

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. Furnish all labor, equipment and materials required to complete all work associated with excavation, including off-site borrow excavation, dewatering, backfill, drainage layers beneath and around structures, foundation and backfill stone, filter fabric, embankments, stockpiling topsoil and any excess suitable material in designated areas, in place compaction of embankments, backfill and subgrades beneath foundations and roadways, excavation support, disposing from the site all unsuitable materials, providing erosion and sedimentation control grading, site grading and preparation of pavement and structure subgrade, and other related and incidental work as required to complete the work shown on the Drawings and specified herein.
- B. All excavations shall be in conformity with the lines, grades, and cross sections shown on the Drawings or established by the Engineer.
- C. It is the intent of this Specification that the Contractor conducts the construction activities in such a manner that erosion of disturbed areas and off-site sedimentation be absolutely minimized.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Requirements of related work are included in Division 1 and Division 2 of these Specifications.

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of the other requirements of the Specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced Specifications, codes, and standards refer to the most current issue available at the time of Bid.
 - 1. Florida Department of Transportation Standard Specifications for Road and Bridge Construction, latest edition.
 - 2. American Society for Testing and Materials (ASTM):
 - ASTM C 127 Test for Specific Gravity and Absorption of Coarse Aggregate
 - ASTM C 136 Test for Sieve Analysis of Fine and Coarse Aggregates
 - ASTM D 422 Particle Size Analysis of Soils
 - ASTM D 423 Test for Liquid Limit of Soils
 - ASTM D 424 Test for Plastic Limit and Plasticity Index of Soils

ASTM C 535	Test for Resistance to Degradation of Large Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM D 698	Standard Method of Test for the Moisture - Density Relations of Soils Using a 5.5 lb. (2.5 kg) Rammer and a 12-inch (305 mm) Drop
ASTM D1556	Test for Density of Soil in Place by the Sand-Cone Method
ASTM D1557	Test for Moisture-Density Relations of Soils and Soil Aggregate Mixtures Using 10-lbs. (4.5 kg) Rammer and 18-inch (457 mm) Drop
ASTM D2049	Test Method for Relative Density of Cohesionless Soils
ASTM D2167	Test for Density of Soil in Place by the Rubber-Balloon Method
ASTM D2216	Test for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil Aggregate Mixtures
ASTM D2487	Test for Classification of Soils for Engineering Purposes
ASTM D6938	Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

1.04 SUBSURFACE CONDITIONS

- A. Subsurface information in the area of the proposed structures is not available.
- B. The Contractor shall examine the site and undertake its own subsurface investigation prior to submitting its bid, taking into consideration all conditions that may affect its work.
- C. The Contractor shall satisfy itself as to the character and amount of different soil materials, groundwater and the subsurface conditions to be encountered in the work to be performed. No claim for extra compensation or for extension of time will be allowed on account of subsurface conditions inconsistent with Contractor's assumptions.
- D. Attention is directed to the fact that there may be water pipes, storm drains and other utilities located in the area of proposed excavation. Locate existing underground utilities in areas of work. Test pits and hand excavation in critical areas will be required prior to initiating work. Perform all repairs to same in the event that excavation activities disrupt service.
- E. All existing utilities including piping, electrical conduits, electrical duct banks and telephone cables that are shown on the Contract Documents to be relocated, shall be relocated prior to initiating earthwork. Excavation and backfill for relocation of existing utilities shall conform to the requirements of Section 02222 entitled "Excavation and Backfill for Utilities". The Contractor shall coordinate relocation of utilities with utility companies having jurisdiction in the area. Should unknown or incorrectly identified piping or other utilities be encountered during excavation, the Contractor shall consult the OWNER and the Engineer immediately for directions.

- F. The Contractor shall cooperate with the OWNER and utility companies in keeping respective services and facilities in operation.

1.05 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in Section 01300 - Submittals, the Contractor shall submit the following:
 - 1. Name and location of all material suppliers.
 - 2. Certificate of compliance with the standards specified above for each source of each material.
 - 3. List of disposal sites for waste and unsuitable materials and all required permits for use of those sites.
 - 4. Plans and cross sections of open cut excavations showing side slopes and limits of the excavation at grade.
 - 5. Construction drawings and structural calculations for any types of excavation support required. Drawings and calculations shall be signed and sealed by a currently registered Professional Engineer in the State of Florida.
 - 6. Monitoring plan and pre-construction condition inspection and documentation of all adjacent structures, utilities, and roadways near proposed installation of excavation support systems.
 - 7. The Contractor shall notify the Engineer of the off-site or on-site sources of structural fill and submit to the Engineer a representative sample weighing approximately 50 lbs. The sample shall be delivered to a designated location on site.
 - 8. Prior to any earthwork, the Contractor shall submit a sieve analysis of the proposed structural fill to Engineer for review and approval.
 - 9. The Contractor shall not place any foundation reinforcement steel or formwork until excavations have been tested for compaction.
 - 10. The Contractor shall apply for and obtain all necessary permits for dewatering as necessary. Contractor shall be responsible for all permit fees.

1.06 QUALITY CONTROL

- A. All soils testing shall be performed by an independent testing laboratory retained by the OWNER as specified in Section 01400 entitled "Quality Control". The Contractor shall schedule its Work so as to permit a reasonable time for testing before placing succeeding lifts of backfill and shall keep the laboratory informed of its progress. In the event any test shows the work is not in conformance with these Contract Documents, the cost of any subsequent testing to show conformance shall be borne by the Contractor. All test results shall be sent directly to the Engineer.

1.07 PRODUCT HANDLING

- A. Soil and rock material shall be excavated, transported, placed, and stored in a manner so as to prevent contamination, segregation and excessive wetting. Materials which have become contaminated or segregated will not be permitted in the performance of the work and shall be removed from the site.

1.08 GROUNDWATER

- A. The Contractor shall be responsible for anticipating groundwater conditions and shall provide positive control measures as required. Such measures shall ensure construction in the dry, stability of excavations, groundwater pressure control, prevention of tanks, pipes, and other structures from being lifted by hydrostatic pressures, and avoiding the disturbance of subgrade bearing materials.
- B. Reference the Section entitled "Dewatering" accordingly.

1.09 USE OF EXPLOSIVES

- A. The use of explosives for excavation work is strictly prohibited on this project.

1.10 PROTECTION OF PROPERTY AND STRUCTURES

- A. The Contractor shall, at its own expense, sustain in place and protect from direct or indirect injury, all pipes, poles, conduits, walls, buildings, and all other structures, utilities, and property in the vicinity of its work. The Contractor shall take all risks attending the presence of proximity of pipes, poles, conduits, walls, buildings, and all other structures, utilities, and property in the vicinity of its work. He shall be responsible for all damage, and assume all expenses, for direct or indirect injury and damage, caused by its work, to any such pipe, structures, etc., or to any person or property, by reason of injury to them, whether or not such structures, etc., are shown on the Drawings.

PART 2 -- PRODUCTS

2.01 SELECT FILL

- A. Soils from the excavations meeting requirements stipulated herein with the exceptions of topsoil and organic material may be used as select fill for backfilling, constructing embankments, reconstructing existing embankments, and as structural subgrade support. All fill material used for embankment construction shall be provided by the Contractor from any excess suitable on-site or from off-site sources, all subject to review by the Engineer prior to use. The Contractor must determine the volume of material required for the site.
- B. Select fill used for embankment construction shall be non-cohesive, non-plastic, granular mixture of local sand and limerock, shall be free from vegetation, organic material or muck, and shall not contain more than 8 percent material by weight which passes the No. 200 sieve. Broken concrete shall not be used in the fill. Fill material for embankment construction containing limerock shall have sufficient sand to fill the voids in the limerock, and no individual rocks or pieces or hard material that will not pass a 6-inch diameter ring shall be used in the fill; except that the upper 4-inches of all backfill or fills shall not contain any rock or hard material that will not pass a 3-inch diameter ring.

- C. Select fill used for backfilling shall either be material as described in Paragraph B or a granular soil material with a maximum Plasticity Index (PI) of 6. Backfill against walls shall not contain any rock larger than ½-inches.
- D. Select fill used under structures (structural fill) shall be furnished from off-site or on-site sources as required. Structural fill material shall be clean sand or sand and limerock free from vegetation, organic material, muck, or other deleterious matter. Not more than 10 percent by weight shall pass the No. 200 sieve and shall have a Unified Soil Classification System designation of GP, GW, GP-GM, GW-GM, SP, SW, SP-SM, or SW-SM. All rock shall pass through a 3-inch diameter ring. Broken Portland cement or asphaltic concrete will not be considered an acceptable fill material. Unsuitable Fill Material: Classified as A-2-4, A-2-5, A-2-6, A-2-7, A-4, A-5, A-6, A-7, and A-8 in accordance with AASHTO Designation M 145. Peat and other highly organic soils are also unsuitable as structural fill.
- E. Regardless of material used as select fill, materials shall be compacted at a moisture content satisfactory to the Engineer, which shall be approximately that required to produce the maximum density except that the moisture content shall not be more than 2% below nor more than 2% above the optimum moisture content for the particular material tested in accordance with the ASTM D1557.
- F. Select fill used as subgrade support shall be a coarse aggregate material meeting the gradation requirements of #57 or #67 aggregates in accordance with ASTM C-33.
- G. Where excavated material does not meet requirements for select fill, Contractor shall furnish off-site borrow material meeting the specified requirements herein.

2.02 CLEAN SAND

- A. Clean sand for use in backfilling shall be furnished from off-site or on-site sources as required. Material shall be clean sand free from vegetation, organic material, muck, or other deleterious material. Not more than 10 percent by weight shall pass the No. 200 sieve and shall have a classification of A-3 in accordance with AASHTO Designation M 145.

2.03 TOPSOIL

- A. Topsoil shall be considered the surface layer of soil and sod, suitable for use in seeding and planting. It shall contain no mixture of refuse or any material toxic to plant growth.

2.04 GEOTEXTILES

- A. The Contractor shall provide geotextiles as indicated on the Drawings and specified herein.

2.05 CRUSHED STONE

- A. Crushed Stone: Crushed stone shall consist of hard, durable, subangular particles of proper size and gradation, and shall be free from organic material, wood, trash, sand, loam, clay, excess fines, and other deleterious materials. Crushed stone shall conform to the requirements of ASTM C 33, Size Number 57, graded within the following limits:

<u>Sieve Size</u>	<u>Percent Finer by Weight</u>
1 ½ inch	100
1 inch	95 to 100
½ inch	25 to 80
No. 4	0 to 10
No. 8	0 to 5

- B. Crushed stone shall be carefully placed and spread to a minimum depth of 6 inches unless indicated otherwise on the Drawings. Final grades and locations shall be as indicated on the Drawings.

2.06 WEED CONTROL FABRIC

- A. General: All gravel beds and areas of crushed stone shown on the Drawings shall include an underline of weed control fabric as specified herein.
- B. Manufacturer and Product, or Equal:

Manufacturer	Product
DeWitt Company	Roc-Kloth TM
Easy Gardener Products, Inc.	Pro WeedBlock

PART 3 -- EXECUTION

3.01 STRIPPING OF TOPSOIL

- A. In all areas to be excavated, filled, paved, or graveled, the topsoil shall be stripped to its full depth and shall be deposited in storage piles on the site, at locations designated by the Engineer, for subsequent reuse. Remove all tree stumps, concentration of roots and other deleterious materials. Topsoil shall be kept separated from other excavated materials and shall be piled free of roots and other undesirable materials. Areas shall be cleared, grubbed, and stripped an area at least 10 feet beyond the maximum outside perimeter of structures and at least 5 feet beyond paved areas.

3.02 EXCAVATION

- A. Unsuitable material within structure footprints is expected. Highly organic soils (peat or muck), weak silty materials, asphalt and concrete shall be removed from all foundation areas. In addition, all sandy silt zones shall be completely removed from mat foundation and footing areas. Unsuitable material within structure footprints shall be over-excavated and backfilled with structural fill.
- B. All excavation shall be made in such manner, and to such widths, as will give ample room for properly constructing and inspecting the structures they are to contain. As a minimum, excavations shall be carried 5-feet outside slab or footing limits or by one foot for each foot excavated below the bearing grade of the mat or footing, whichever is less, unless

noted otherwise. A 12-inch over-excavation and subsequent backfill shall be performed at all structure footings.

- C. All material excavated, regardless of its nature or composition, shall be classified as UNCLASSIFIED EXCAVATION. Excavation shall include the removal of all soil, rock, and weathered rock, rocks of all types, boulders, conduits, pipe, and all other obstacles encountered and shown to be removed within the limits of excavation shown on the Drawings or specified herein. The cost of excavation shall be included in the Lump Sum Bid Price and no additional payment will be made for the removal of obstacles encountered within the excavation limits shown on the Drawings and specified herein.
- D. Excavated unsuitable material shall be removed from the site and disposed of by the Contractor.
- E. All suitable material removed in the excavation shall be used as far as practicable in the formation of embankments, subgrades, and shoulders, and at such other places as may be indicated on the Drawings or indicated by the Engineer. No excavation shall be wasted except as may be permitted by the Engineer. Refer to the drawings for specific location and placement of suitable excavated materials in the formation of embankments, backfill, and structural and roadway foundations. **THE ENGINEER WILL DESIGNATE MATERIALS THAT ARE UNSUITABLE.** The Contractor shall furnish off-site disposal areas for the unsuitable material and shall dispose of unsuitable material at such areas. Where suitable materials containing excessive moisture are encountered above grade in cuts, the Contractor shall construct above grade ditch drains prior to the excavation of the cut material when in the opinion of the Engineer such measures are necessary to provide proper construction.
- F. All excavations shall be made in the dry and in such a manner and to such widths as will give ample room for properly constructing and inspecting the structures and/or piping they are to contain and for such excavation support, pumping and drainage as may be required. Excavation shall be made in accordance with the grades and details shown on the Drawings and as specified herein.
- G. Excavation slopes shall be flat enough to avoid slides that will cause disturbance of the subgrade or damage of adjacent areas, and if required to protect the safety of workmen, the general public, this or other work or structure, or excavation walls, the excavation shall be properly sheeted and braced for conditions encountered and OSHA requirements. The Contractor shall intercept and collect surface runoff both at the top and bottom of cut slopes. The intersection of slopes with natural ground surfaces, including the beginning and ending of cut slopes, shall be uniformly rounded as shown on the Drawings or as may be indicated by the Engineer. Concurrent with the excavation of cuts the Contractor shall construct intercepting berm ditches or earth berms along and on top of the cut slopes at locations shown on the Drawings or designated by the Engineer. All slopes shall be finished to reasonably uniform surfaces acceptable for seeding and mulching operations. No rock or boulders shall be left in place, which protrude more than 1 foot within the typical section cut slope lines, and all rock cuts shall be cleaned of loose and overhanging material. All protruding roots and other objectionable vegetation shall be removed from slopes. The Contractor shall be required to submit plans of open-cut excavation for review by the Engineer before approval is given to proceed.

- H. It is the intent of these Specifications that all structures shall bear on an aggregate base as specified in Article 2.01 F above as shown on the Drawings or not less than 6-inches, structural fill specified in Article 2.01D, or in place granular soils. Bedding for process piping shall be as specified in the Section entitled "Excavation and Backfill for Utilities", or as shown on the Drawings.
- I. The bottom of all excavations for structures and pipes shall be examined by the Engineer for bearing value and the presence of unsuitable material. If, in the opinion of the Engineer, additional excavation is required due to the low bearing value of the subgrade material, or if the in-place soils are soft, yielding, pumping and wet, or if the limestone formation has been exposed and solution features in the form of slots or chimneys are found, the Contractor shall remove such material to the required width and depth and replace it with material acceptable to the Engineer. No payment will be made for subgrade disturbance caused by inadequate dewatering or improper construction methods.
- J. All cuts shall be brought to the grade and cross section shown on the Drawings, or established by the Engineer, prior to final inspection and acceptance by the Engineer.
- K. Slides and over-breaks which occur due to negligence, carelessness or improper construction techniques on the part of the Contractor shall be removed and disposed of by the Contractor as indicated by the Engineer at no additional cost to the OWNER. If grading operations are suspended for any reason whatsoever, partially completed cut and fill slopes shall be brought to the required slope and the work of seeding and mulching or other required erosion and sedimentation control operations shall be performed.
- L. Where the excavation exposes sludge, sludge contaminated soil or other odorous materials, the Contractor shall cover such material at the end of each workday with a minimum of 6-inches and a maximum of 24-inches of clean fill. The work shall be an odor abatement measure and the material shall be placed to the depth deemed satisfactory by the Engineer for this purpose.
- M. The Contractor shall ensure that its excavation work does not adversely affect the bearing capacity of the structural subsurface. Also, the Contractor shall proceed with foundation work immediately after excavation work and as expeditiously as possible so as to minimize any potential for subsurface disturbance due to environmental factors, adverse weather, etc. The Contractor shall also take all necessary precautions to protect its work from potential adverse impacts. Where excavated areas are disturbed by subsequent operations or adverse weather, scarify surface, reshape, fill as required and compact to required density.

3.03 UNAUTHORIZED EXCAVATION

- A. Excavation Work carried outside of the Work limits required by the Contract Documents shall be at the Contractor's expense, and shall be backfilled by the Contractor at its own expense with suitable material, as directed by the Engineer. Where, in the judgment of the Engineer, such over-excavation requires use of lean concrete or crushed stone, the Contractor, at its expense shall furnish and place such materials.

3.04 EXCAVATION SUPPORT

- A. The Contractor shall furnish, place, and maintain such excavation support which may be required to support sides of excavation or to protect pipes and structures from possible damage and to provide safe working conditions. Excavation for deep structures shall be sufficient to provide a clearance between their outer surfaces and the face of the excavation, excavation support, or bracing, of not less than 3 feet. Materials encountered in the excavation which have a tendency to slough or flow into the excavation, undermine the bank, weaken the overlying strata, or are otherwise rendered unstable by the excavation operation shall be retained by an excavation support, stabilization, grouting or other acceptable methods. If the Engineer is of the opinion that at any point sufficient or proper supports have not been provided, it may order additional supports put in at the expense of the Contractor. The Contractor shall be responsible for the adequacy of all supports used and for all damage resulting from failure of support system or from placing, maintaining and removing it.
- B. Selection of and design of any proposed excavation support systems is exclusively the responsibility of the Contractor. Excavation support shall comply with all applicable OSHA requirements. Contractor shall submit drawings and calculations on proposed systems sealed by a Professional Engineer currently registered in the State of Florida.
- C. The Contractor shall exercise caution in the installation and removal of supports to insure that excessive or unusual loadings are not transmitted to any new or existing structure. The Contractor shall promptly repair at its expense any and all damage that can be reasonably attributed to installation or removal of excavation support system.
- D. Contractor shall monitor movement in the excavation support systems as well as movement at adjacent structures, utilities and roadways near excavation supports. Contractor shall submit a monitoring plan developed by the excavation support design engineer. All pre-construction condition assessment and documentation of adjacent structures on-site and off-site shall be performed by the Contractor. If any sign of distress such as cracking or movement occurs in any adjacent structure, utility or roadway during installation of supports, subsequent excavation, service period of supports, subsequent backfill and construction, or removal of supports, Engineer shall be notified immediately. Contractor shall be exclusively responsible for any damage to any roadway, structure, utility, pipes, etc. both on-site and off-site, as a result of its operations.
- E. All excavation supports shall be removed upon completion of the work, except as indicated herein, provided its removal will not jeopardize existing or new pipes or structures. The Engineer may permit supports to be left in place at the request and expense of the Contractor. Any excavation supports left in place shall be cut off at least two (2) feet below the finished ground surface or as directed by the Engineer.

3.05 PROTECTION OF SUBGRADE

- A. To minimize the disturbance of bearing materials and provide a firm foundation, the Contractor shall comply with the following requirements:
 - 1. Use of heavy rubber-tired construction equipment shall not be permitted on the final subgrade unless it can be demonstrated that drawdown of groundwater throughout the entire area of the structure is at least 3 feet below the bottom of the

excavation (subgrade). Even then, the use of such equipment shall be prohibited should subgrade disturbance result from concentrated wheel loads.

2. Subgrade soils disturbed through the operations of the Contractor shall be excavated and replaced with compacted select fill or crushed stone at the Contractor's expense as indicated by the Engineer.
3. The Contractor shall provide positive protection against penetration of frost into materials below the bearing level during work in winter months. This protection can consist of a temporary blanket of straw or salt hay covered with a plastic membrane or other acceptable means.

3.06 PROOF-ROLLING

- A. Proof-rolling of in-place granular soils shall be performed on the subgrade of all structures and all areas that will support pavements or select fill. After stripping of topsoil, excavation to subgrade and prior to placement of fills, the exposed subgrade shall be carefully inspected by probing and testing as needed. Any topsoil or other organic material still in place, frozen, wet, soft, or loose soil, and other undesirable materials shall be removed. The exposed subgrade shall be proof-rolled with a self propelled vibratory roller which imparts a dynamic force of not less than 20,000 pounds. In areas between 5 and 25 feet from existing structures, a maximum drum roller weight of 4 tons shall be used. Areas within 5 feet of an existing structure shall be proof-rolled with a walk behind vibratory sled or roller. Proof-rolling shall continue to check for pockets of soft material hidden beneath a thin crust of better soil and until no further vertical settlement of the surface is visually discernable. Any unsuitable materials thus exposed shall be removed and replaced with an approved compacted material.

3.07 EMBANKMENTS

- A. The Contractor shall perform the construction of embankments in such a manner that cut and fill slopes will be completed to final slopes and grade in a continuous operation. The operation of removing excavation material from any cut and the placement of embankment in any fill shall be a continuous operation to completion unless otherwise permitted by the Engineer.
- B. Surfaces upon which embankments are to be constructed shall be stripped of topsoil, organic material, rubbish and other extraneous materials. After stripping and prior to placing embankment material, the Contractor shall compact the top 12-inches of in place soil as specified under Paragraph 3.10, COMPACTION.
- C. Any soft or unsuitable materials revealed before or during the in place compaction shall be removed as indicated by the Engineer and replaced with select fill.
- D. Ground surfaces, on which embankment is to be placed, shall be scarified or stepped in a manner which will permit bonding of the embankment with the existing surface. The embankment soils shall be as specified under Part 2 - Products, and shall be deposited and spread in successive, uniform, approximately horizontal layers not exceeding 8-inches in compacted depth for the full width of the cross section, and shall be kept approximately level by the use of effective spreading equipment. Hauling shall be

distributed over the full width of the embankment, and in no case will deep ruts be allowed to form during the construction of the embankment. The embankment shall be properly drained at all times. Each layer of the embankment shall be thoroughly compacted to the density specified under Paragraph 3.10, COMPACTION.

- E. The embankment or fill material in the layers shall be of the proper moisture content before compacting to obtain the prescribed compaction. Wetting or drying of the material and manipulation when necessary to secure a uniform moisture content throughout the layer shall be required. Should the material be too wet to permit proper compaction or rolling, all work on all portions of the embankment thus affected shall be delayed until the material has dried to the required moisture content. Samples of all embankment materials for testing, both before and after placement and compaction, will be taken at frequent intervals. From these tests, corrections, adjustments, and modifications of methods, materials, and moisture content will be made to construct the embankment.
- F. Where embankments are to be placed and compacted on hillsides, or when new embankment is to be compacted against embankments, or when embankment is built in part widths, the slopes that are steeper than 4:1 shall be loosened or plowed to a minimum depth of 6 inches or, if in the opinion of the Engineer, the nature of the ground is such that greater precautions should be taken to bind the fill to the original ground then benches shall be cut in the existing ground as indicated by Engineer.
- G. When rock and other embankment material are excavated at approximately the same time, the rock shall be incorporated into the outer portions of the embankments and the other material which meets the requirements for select fill shall be incorporated into the formation of the embankments. Stones or fragmentary rock larger than 4-inches in their greatest dimension will not be allowed within the top 6-inches of the final grade. Stones, fragmentary rock, or boulders larger than 12-inches in their greatest dimension will not be allowed in any portions of embankments and shall be disposed of by the Contractor as indicated by the Engineer. When rock fragments or stone are used in embankments, the material shall be brought up in layers as specified or directed and every effort shall be exerted to fill the voids with finer material to form a dense, compact mass which meets the densities specified for embankment compaction.

3.08 BACKFILLING

- A. All structures and pipes shall be backfilled with the type of materials shown on the Drawings and specified herein. Select fill shall be deposited in successive, uniform, approximately horizontal layers not exceeding 8-inches in compacted depth for the full width. Stones or fragmentary rock larger than 4-inches in their greatest dimension will not be allowed within the top 6-inches of the ground nor within 6 inches of pipes. No stone or fragmentary rock larger than 12-inches in their greatest dimension will be allowed for any portion of backfill. Compaction shall be in accordance with the requirements of Paragraph 3.09, COMPACTION.
- B. Where excavation support is used, the Contractor shall take all reasonable measures to prevent loss of support beneath and adjacent to pipes and existing structures when supports are removed. If significant volumes of soil cannot be prevented from clinging to the extracted supports, the voids shall be continuously backfilled as rapidly as possible. The Contractor shall thereafter limit the depth below subgrade that supports will be

installed in similar soil conditions or employ other appropriate means to prevent loss of support.

- C. Backfill against concrete or masonry structure shall not be performed until the Work has been reviewed and backfilling permitted. Backfill against walls shall also be deferred until the structural slab for floors above the top fill line have been placed and attained design strength or earlier at the discretion of the Engineer. Partial backfilling against adequately braced wall may be considered by the Engineer on an individual situation basis. Where walls are to be waterproofed, all Work shall be completed and membrane materials dried or cured according to the manufacturer's instructions before backfilling.
- D. Backfill against tanks and other structures which are to retain liquids shall not be performed until leakage tests are completed and accepted by the Engineer in accordance with the Section entitled "Water Tightness Testing".

3.09 COMPACTION

- A. The Contractor shall compact embankments, backfill, crushed stone, aggregate base, and in place subgrade in accordance with the requirements of this Section. The densities specified herein refer to percentages of maximum density as determined by the noted test methods. Compaction of materials on the project shall be in accordance with the following schedule:

	Density % Std. Proctor (D698)	Density % Mod. Proctor (D1557)	Max. Lift Thickness as Compacted Inches
Embankments Beneath Structures*	--	98	8
Other Embankments	95	92	8
Backfill Around Structures	95	92	8
Backfill in Pipe Trenches	95	92	8
Crushed Stone Beneath Structures	**	**	12
Select Sand	--	98	8
Aggregate Base Course (ABC) Beneath Pavements and Structures	--	98	8
Crushed Stone Backfill	**	**	12
Crushed Stone Pipe Bedding	**	**	12
In place Subgrade Beneath Structures	--	95	12

* Embankments beneath structures shall be considered to include a zone 10 feet out from the foundation of the structure extending down to the natural ground on a 45° slope.

** The aggregate shall be compacted to a degree acceptable to the Engineer by use of a vibratory compactor and/or crawler tractor.

- B. Compaction shall be conducted as follows:

1. A vibratory compactor that imparts a dynamic force of not less than 20,000 pounds shall be used. Each section of subgrade shall be subjected to multiple, overlapping (minimum 20% overlap) coverages of the compactor as it operates at normal walking speed. Vibratory equipment shall not be used within 25 feet of any existing structure.
 2. Within 25 feet of any existing structure, non-vibratory compaction equipment such as a drum roller with a maximum weight of 4 tons should be used. Within 5 feet of any existing structure, a walk behind vibratory sled or roller shall be used. A sufficient number of passes should be made within the construction area to compact the in-place soil as required in Article 3.10 A above.
- C. Field density tests will be made by independent testing agency as described in Article 1.06. These tests shall be the basis for accepting or rejecting the compaction. In-place density tests will be performed in accordance with ASTM D 1556, ASTM D 2167, or ASTM D 6938. The Engineer will be the sole judge as to which test method will be the most appropriate. Failure to achieve the specified densities shall require the Contractor to re-compact the material or remove it as required. The Contractor shall, if necessary, increase the compactive effort by increasing the number of passes, using heavier or more suitable compaction equipment, or by reducing the thickness of the layers. The Contractor shall adjust the moisture contents of the soils to bring them within the optimum range by drying them or adding water as required.
- D. Testing will be performed as frequently as deemed necessary by the Engineer. As a minimum, one in-place density test shall be performed for each lift of compacted soil, each 1000 cubic yards of embankment placed, 500 cubic yards of backfill placed, 2500 square feet of foundation area, or one test performed each day for either.
- E. Final grades shall be within 0.1 foot of elevations shown. Where shown on the Drawings surfaces shall be sloped for drainage or other purposes.
- F. Vibration monitoring shall be performed at nearby structures when compaction work is ongoing. A single monitoring point using vibration monitoring equipment capable of detecting velocities of 0.1 inch/second or less and survey measurements shall be used for vibration monitoring at each of the nearest structures. An elevation measurement on nearby structures shall be taken before compaction work starts, and then at least twice a day during the work with one reading taken at the conclusion of the day's operations. Elevation measurements shall be recorded to an accuracy of 0.001 foot. If at any time the Contractor detects settlement or heave of 0.005-feet or more, or vibration levels of 0.5 inch/second or more, the vibratory compaction shall be stopped immediately and the Engineer notified.
- 3.10 REMOVAL OF EXCESS AND UNSUITABLE MATERIALS
- A. The Contractor shall remove and dispose of off-site all unsuitable materials. Within thirty (30) consecutive days after Notice to Proceed, the Contractor shall submit to the Engineer for review all required permits and a list of disposal sites for the unsuitable materials. If the disposal site is located on private property, the submittal shall also include written permission from the owner of record.

- B. All unsuitable materials shall be disposed of in locations and under conditions that comply with federal, state and local laws and regulations.
- C. The Contractor shall obtain an off-site disposal area prior to beginning demolition or excavation operations.
- D. All excess and unsuitable materials shall be hauled in trucks of sufficient capacity and tight construction to prevent spillage. Trucks shall be covered to prevent the propagation of dust.
- E. When all excess and unsuitable material disposal operations are completed, the Contractor shall leave the disposal sites in a condition acceptable to the OWNER and Owner(s) of the disposal site(s).

- END OF SECTION -

SECTION 02260 - FINISH GRADING

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall supply, place, compact and roll finish grade materials.
- B. Finish grade sub-soil.
- C. Cut out areas to receive stabilizing base course materials for paving and sidewalks.
- D. Place, finish grade and compact topsoil.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Excavation and Backfill for Utilities
- B. Excavation and Backfill for Structures

1.03 PROTECTION

- A. The Contractor shall prevent damage to existing structures, fencing, trees, landscaping, natural features, bench marks, pavement, utility lines, and correct all damaged areas at no cost to the Owner.

PART 2 -- PRODUCTS

2.01 MATERIALS

- A. Topsoil shall be friable loam free from subsoil, roots, grass, excessive amount of weeds, stones and foreign matter; acidity range (pH) of 5.5 to 7.5; containing a minimum of 4% and a maximum of 25% organic matter.

2.02 CRUSHED STONE

- A. Crushed stone for general grading purposes shall be as specified in the Section entitled "Excavation and Backfill for Structures".

PART 3 -- EXECUTION

3.01 SUB-SOIL PREPARATION

- A. Rough grade sub-soil systematically to allow for a maximum amount of natural settlement and compaction. Eliminate uneven areas and low spots. Remove debris, roots, branches, stones, etc., in excess of 2 inches in size. Remove sub-soil which has been contaminated with petroleum products or other materials.
- B. Cut out areas, to sub-grade elevation, which are to receive stabilizing base for paving and sidewalks.
- C. Bring sub-soil to required levels, profiles and contours. Make changes in grade gradual. Blend slopes in to level areas.
- D. Slope grade away from building minimum 4 inches in 10 feet (unless indicated otherwise on Drawings).

3.02 PLACING TOPSOIL

- A. Place topsoil in area where seeding, sodding and planting is to be performed. Place to the following minimum depths, up to finished grade elevations:
 - 1. 6-inches for seeded areas.

2. 4 ½-inches for sodded areas.
 3. 24-inches for shrub beds.
 4. 18-inches for flower beds.
- B. Use topsoil in relatively dry state. Place during dry weather.
 - C. Fine grade topsoil eliminating rough and low areas to ensure positive drainage. Maintain levels, profiles and contours of sub-grades.
 - D. Remove stones, roots, grass, weeds, debris and other foreign material while spreading.
 - E. Manually spread topsoil around trees, plants, buildings and other structures to prevent damage which may be caused by grading equipment.
 - F. Lightly compact placed topsoil.
- 3.03 SURPLUS MATERIAL
- A. Remove surplus sub-soil and topsoil from site.
 - B. Leave stockpile areas and entire job site clean and raked, ready to receive landscaping.

- END OF SECTION -

SECTION 02510 - ASPHALTIC CONCRETE PAVEMENT

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. Construct asphaltic concrete pavement in accordance with the lines, grades and typical sections as indicated on the Drawings, specified herein and as required for a complete installation.
- B. Replace and / or repair all existing asphaltic concrete pavement areas impacted by contractor operations, including trenching for new utilities, as well as damage that may result from contractor operations during the progress of the Work.
- C. Temporary asphalt / trench repairs shall be installed within 1 week of excavation and backfill work on plant roadways impacted by construction.

1.02 SUBMITTALS

- A. The CONTRACTOR shall submit its proposed formulae for the asphaltic concrete paving for review in accordance with the Section entitled "Submittals".

1.03 QUALITY CONTROL

- A. The phrase "DOT Specifications" shall refer to the Florida Department of Transportation Standard Specifications for Road and Bridge Construction. The DOT Specifications, are referred to herein and are hereby made a part of this Contract to the extent of such references, and shall be as binding upon the Contract as though reproduced herein in their entirety.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Limerock Base: The limerock base shall consist of two courses of Miami Oolite limerock in accordance with Sections 200 and 911 of the DOT Specifications.
- B. Prime Coat: The material used for the prime coat shall be cut-back Asphalt Grade RC-70 conforming to Sections 300 and 916 of the DOT Specifications for prime to be used on Miami Oolite formation limerock.
- C. Asphaltic Concrete: Type SP 9.5 and SP 12.5 meeting the requirements in Section 334 of the DOT Specifications.
- D. Reclaimed Asphalt: Reclaimed asphalt shall not be utilized.

- E. Tack Coat: The material used for the tack coat shall be emulsified asphalt grade RS-2 conforming to DOT Sections 300 and 916.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. Subgrade: Roadway subgrades shall be stabilized to the minimum depth shown on the Drawings to a Florida Bearing Value (FBV) of not less than 75. Stabilizing shall be type C as defined in Section 160 of the DOT specifications. Stabilization may require the addition and thorough mixing in of crushed limerock, coarse limerock screenings, or any other stabilizing material acceptable to the Engineer. The stabilizing material shall be applied in such quantity that, after mixing and blending, the subgrade will have a FBV of not less than 75. Stabilizing material shall be mixed or blended in the subgrade material by plowing, scarifying, disking, harrowing, blading and mixing with rotary tillers until the mixed materials are of uniform bearing value throughout the width and depth of the layer being processed. The minimum acceptable density at any location will be 100 % of maximum dry density as determined by AASHTO T-180.
- B. At least three density determinations shall be made on each day's final compaction operations on each course and the density determinations shall be made at more frequent intervals if deemed necessary by the Engineer.
- C. Limerock Base: The limerock base shall be constructed in accordance with Section 200 of the DOT Specifications, to the thickness and width indicated on the Drawings. Pavement base shall be constructed in two lifts.
- D. After spreading of the base material is completed, the entire surface shall be scarified and shaped so as to produce the exact grade and cross section after compaction. For double course base, this scarifying shall extend a depth sufficient to penetrate slightly the surface of the first course. The maximum depth of each lift shall be 6-inches.
- E. When the material does not have the proper moisture content to insure the required density, wetting or drying shall be required. If the material is deficient in moisture, water will be added and uniformly mixed in by disking the base course to its full depth. If the material contains an excess of moisture, it shall be allowed to dry before being compacted. Wetting and drying operations shall involve manipulation of the entire width and depth of the base as a unit. As soon as proper conditions of moisture are attained, the material shall be compacted to an average density not less than 98% of maximum dry density as determined by AASHTO T-180. Where the base is being constructed in more than one course, the density shall be obtained in each lift of the base.
- F. During final compacting operations, if blading of any areas is necessary to obtain the true grade and cross section, the compacting operations for such areas shall be completed prior to making the density determination on the finished base.

- G. Unless otherwise directed by the Engineer, the surface shall be "hard-planed" with a blade grader immediately prior to the application of the prime coat to remove the thin glaze or cemented surface and to allow free penetration of the prime material. The materials planed from the base shall be removed from the base area.
- H. If cracks or checks appear in the base, either before or after priming, which in the opinion of the Engineer, would impair the structural efficiency of the base course, the Contractor shall remove such cracks or checks by re-clarifying, reshaping, adding base material where necessary and re-compacting, at no additional cost to the Owner.
- I. Mixing Base and Subgrade: If at any time the subgrade material shall become mixed with the base course material, the Contractor shall, without additional compensation, dig out and remove the mixture, reshape and compact the subgrade and replace the materials removed with clean base material, which shall be shaped and compacted as specified above.
- J. Prime Coat: The prime coat shall be applied at a rate of 0.15 gallons per square yard and the work performed in accordance with Section 300 of the DOT Specifications.
- K. Asphaltic Concrete: The spreading, compacting and jointing the wearing surface shall be in accordance with Sections 330 and 333 of the DOT Specifications to the thickness indicated on the Drawings.
- L. Tack Coat: Apply tack coat at a rate between 0.02 and 0.10 gallons per square yard, and perform the Work in accordance with Section 300 of the DOT Specifications.

3.02 TEMPORARY TRENCH REPAIR OR STABILIZATION

- A. Following trenching and backfill within active plant roadways, but prior to final asphalt replacement at substantial completion, the Contractor shall install temporary trench repair, consisting of compacted base course and temporary asphalt.
- B. Temporary trench repair shall include the preparation of the subgrade, the placing and compacting of the limerock base, the priming of the base, the placing and maintaining of the surface treatment, all as specified herein.
- C. The width of trench repairs shall extend at least 12 inches beyond the limits of the asphalt impacted by excavation. The edge of the pavement to be left in place shall be cut to a true edge with a saw or other approved method so as to provide a clean edge to abut the repair. The line of the repair shall be reasonably uniform with no unnecessary irregularities.

3.03 PAVEMENT MARKINGS

- A. All existing markings (i.e., lanes, edge of pavement, parking stalls, etc.) impacted by the Contractor during construction shall be replaced with new painted items in accordance with the requirements of Section 971 of the DOT Specifications.

3.04 CONNECTIONS WITH EXISTING FACILITIES

- A. Where the bituminous pavement is to be connected with an existing roadway surface or other facility, the Contractor shall modify the existing roadway profile in such a manner as to produce a smooth riding connection to the existing facility.
- B. Where it is necessary to remove existing asphalt surfaces to provide proper meet lines and riding surfaces, the Contractor shall saw cut the existing surface so that there will be sufficient depth to provide a minimum of 1-inch of asphalt concrete, and the waste material shall be disposed of to the satisfaction of the Engineer. Prior to placing the asphalt concrete, these areas shall be tacked. Meet lines shall be straight and the edges vertical. The edges of meet line cuts shall be painted with liquid asphalt or emulsified asphalt prior to placing asphalt concrete. After placing the asphalt concrete, the meet line shall be sealed by painting with a liquid asphalt or emulsified asphalt and immediately covered with clean, dry sand.

3.05 SURFACE TOLERANCE

- A. Tests for conformity with the specified grade shall be made immediately after initial compression. Any variation shall be immediately corrected by the removal or addition of materials and by continuous rolling.
- B. The completed surface of the pavement shall be of uniform texture, smooth, uniform as to grade, and free from defects of all kinds. The completed surface shall not vary more than 1/8 inch from the lower edge of a 12-foot straightedge placed on the surface along the centerline or across the trench.
- C. After completion of the final rolling, the smoothness and grade of the surface shall again be tested by the Contractor.
- D. When deviations in excess of the above tolerances are found, the pavement surface shall be corrected as stated in Section 330-12.4 of the DOT Specifications.
- E. All areas in which the surface of the completed pavement deviates more than twice the allowable tolerances described above shall be removed and replaced to the satisfaction of the Engineer.

3.06 WEATHER CONDITIONS

- A. Asphalt shall not be applied to wet material. Asphalt shall not be applied during rainfall or any imminent storms that might adversely affect the construction. The Engineer will determine when surfaces and materials are dry enough to proceed with construction. Asphalt concrete shall not be placed during heavy rainfall or when the surface upon which it is to be placed is wet.

3.07 PROTECTION OF STRUCTURES AND ADJUSTMENT OF APPURTENANCES

- A. Provide whatever protective coverings may be necessary to protect the exposed portions of bridges, culverts, curbs, gutters, posts, guard fences, road signs, and any other structures from splashing oil and asphalt from the paving operations. Remove any oil, asphalt, dirt, or any other undesirable matter that may come upon these structures by reason of the paving operations.
- B. Where water valve boxes, manholes, catch basins, or other underground utility appurtenances are within the area to be surfaced, the Contractor shall adjust the covers of these improvements to conform with the proposed surface elevations.
- C. In this effort, the Contractor shall be responsible for ensuring that appurtenances are brought to proper grade to conform with finished surface elevations and any delays experienced from such obstructions will be considered as incidental to the paving operation. No additional payment will be made. Protect all covers during asphalt application.

3.08 PAVEMENT WARRANTY

- A. Settlement of replaced pavement over trenches within the warranty period shall be considered the result of improper or inadequate compaction of the sub-base or base materials. The Contractor shall promptly repair all pavement deficiencies noted during the warranty period at the Contractor's sole expense.

- END OF SECTION -

SECTION 02526 -- CONCRETE PAVEMENT, CURB AND WALKWAYS

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. Concrete pavement, curbs and sidewalk shall be constructed to the lines and grades and dimensions required for a complete installation as shown on the Drawings and specified herein.

1.02 SUBMITTALS

- A. Shop drawings for reinforcing, joint material and mix designs shall be submitted for review in accordance with the Section entitled "Submittals".

PART 2 - PRODUCTS

2.01 CONCRETE

- A. Concrete shall be Class B, conforming to the Section entitled "Cast-in-Place Concrete", unless noted or specified otherwise.

2.02 REINFORCING AND WELDED WIRE FABRIC

- A. Joint reinforcing and welded wire fabric shall conform to the section entitled "Concrete Reinforcement".

2.03 JOINT SEALER FOR PAVEMENT

- A. Joint sealer shall be a one or two part polysulfide base self leveling sealant for horizontal surfaces that has been developed for foot and vehicular traffic. The sealant shall conform to the requirements of the section entitled "Sealants and Caulking".

2.04 PREFORMED JOINT FILLER

- A. Preformed joint filler shall be sponge rubber and conform to the requirements of AASHTO Designated M148, Type 1.

PART 3 - EXECUTION

3.01 SUBGRADE CONDITION

- A. The finished subgrade shall be maintained in a smooth, compact condition and any areas which are disturbed prior to placing of the concrete shall be restored at Contractor expense. The subgrade shall be moist at the time the concrete is placed. Water shall be uniformly applied ahead of the paving operations as directed by the Engineer. If the Contractor does not maintain the subgrade in the required moist condition, a vapor barrier sheet will be required between the subgrade and the concrete.
- B. The subgrade shall be accurately trimmed to the required elevation with a 1/4-inch tolerance. High areas shall be trimmed to proper elevation. Low areas may be filled with suitable material and compacted to the specified density or filled with concrete integrally with the placing of the pavement.

3.02 SETTING FORMS

- A. The forms shall be accurately set to line and grade and such that they rest firmly, throughout their entire length, upon the compacted subgrade surface. Forms shall be joined neatly and tightly and braces to test the pressure of the concrete and the finishing operations. The alignment and grade of all forms shall be approved before and immediately prior to the placing of concrete.

3.03 MIXING CONCRETE

- A. Concrete shall be mixed in accordance with the Section entitled "Cast-in-place Concrete".

3.04 PLACING CONCRETE

- A. The concrete shall be distributed on the subgrade to such depth, that, when it is consolidated and finished, the slab thickness required by the Drawings will be obtained at all points and the surface will at no point be below the grade specified for the finished surface, after application of the allowable tolerance. The concrete shall be deposited on the subgrade in a manner which will require as little re-handling as possible.
- B. Fabric reinforcement shall be placed at mid slab depth, and the fabric shall be maintained at this location during the placing and finishing operations.
- C. Concrete shall be thoroughly consolidated against and along the faces of all forms, by means of hand-operated, spud-type vibrators. Vibrators shall not be permitted to come in contact with the subgrade or a side form. Vibration at any one location shall not continue so long as to produce puddles or the accumulation of excessive grout on the surface. In no case shall the vibrator be operated longer than 15 seconds in any one location.

3.05 STRIKING-OFF, CONSOLIDATING AND FINISHING CONCRETE

- A. Immediately after the placing, the concrete shall be struck off, consolidated and finished, to produce a finished pavement conforming to the cross section, width and surface. Sequence of operations shall be as follows: strike-off; vibratory consolidation; screeding; floating; removal of laitance; straight-edging; and final surface finish.

3.06 STRAIGHTEDGING AND SURFACE CORRECTIONS

- A. After floating has been completed and the excess water removed, but while the concrete is still in a plastic state, the surface of the concrete shall be tested for trueness with an accurate 10 foot straightedge. The straightedge shall be furnished by the Contractor. The straightedge shall be held in successive positions parallel to the road center line, in contact with the surface, and the whole area tested from one side of the slab to the other as necessary. any depressions shall be immediately filled with freshly mixed concrete and struck-off; consolidated and refinished. High areas shall be cut down and refinished. Straightedge testing and surface correction shall continue until the entire surface appears to conform to the required grade and cross section.

3.07 FINAL FINISH

- A. As soon as the water sheen has disappeared from the surface of the pavement and just before the concrete becomes non-plastic, a light broom finish shall be given to the surface.

3.08 EDGING

- A. After the final finish has been applied, but before the concrete has become non-plastic, the edges of the pavement along each side of the strip being placed, on each side of construction joints and along any structure extending into the pavement, shall be carefully rounded to a ¼-inch radius except as otherwise indicated. A well-defined and continuous radius shall be produced and a smoother, dense mortar finish obtained. All concrete shall be completely removed from the top of the joint filler.
- B. All joints shall be checked with a straightedge before the concrete has become non-plastic and, if one side of the joint is higher than the other or the entire joint is higher or lower than the adjacent slabs, corrections shall be made as necessary.

3.09 JOINTS

- A. Construction Joints shall be located as shown on the Drawings and/or as directed by the Engineer.
- B. Expansion joints shall be formed by placing pre-molded expansion joint material about all structures and features projecting through, into or against the pavement. Unless otherwise indicated, such joints shall be ½-inch in width.
- C. Open type transverse expansion joints shall be provided at all sidewalk returns and at 50 feet intervals and wherever indicated on the Drawings. Open type joints shall be formed by staking a ¼-inch thick metal bulkhead in place and placing concrete on both sides. After the concrete has set sufficiently to preserve the width and shape of the joint, the bulkhead shall be removed. After the sidewalk has been finished over the joint, the slot shall be opened and edged with a tool having a ½-inch radius. Transverse expansion joints shall be cleaned and filled with joint filler strips ¼-inch thick conforming to the requirements of AASHTO M-153.
- D. Scored joints shall be either formed or sawed at 5-foot intervals and shall extend to a depth of at least one fourth of the sidewalk slab thickness.

3.10 CURING

- A. After the finishing operations have been completed and as soon as the concrete has hardened sufficiently that marring of the surface will not occur, the entire surface and the edges of the newly placed concrete shall be covered and cured with membrane curing compound.
- B. Curing compound shall be uniformly applied to the surfaces to be cured, in a single coat, continuous film, at the rate of one gallon to not more than 200 square feet, by a mechanical sprayer.
- C. Curing compound shall not be applied during periods of rainfall. Curing compound shall not be applied to the inside faces of joints to be sealed. Should the film become damaged from any cause within the required curing period, the damaged portions shall be repaired immediately with additional compound. Upon removal of side forms, the sides of the slabs exposed shall immediately be coated to provide a curing treatment equal to that provided for the surface.

3.11 CURB AND SIDEWALK CONSTRUCTION

- A. Concrete curbs and sidewalks shall be constructed on a prepared smooth subgrade of uniform density. Large boulders and other obstructions shall be removed to a minimum depth of 6 inches below the finished subgrade elevation and the space shall be backfilled with sand, base course material or other suitable material which shall be thoroughly compacted by rolling or tamping. The Contractor shall furnish a template and shall thoroughly check the subgrade prior to depositing concrete.
- B. Concrete for curbs and sidewalks shall be formed, mixed, placed and finished in conformance with the requirements of Division 3, except as modified herein. Concrete shall be cured with a clear membrane curing compound which shall be applied at a uniform rate of one gallon per 200 square feet in accordance with the requirements specified herein. Sidewalks shall be given a light broom finish.

3.12 CURBS

- A. Curbs shall be constructed in uniform sections ten feet in length except where shorter sections are necessary for closures or arcs. The sections shall be separated by sheet metal templates set perpendicular to the face and tip of the curve and not less than 2 inches longer than the depth of the curb. The templates shall be held firmly during the

placing of the concrete and shall be allowed to remain in place until the concrete has set sufficiently to hold its shape, but shall be removed while the forms are still in place.

- B. After the concrete has sufficiently set for a minimum of 12 hours, the Contractor shall remove the forms and backfill the spaces on each side. The earth shall be compacted in satisfactory manner without damage to the concrete Work. Minor defects shall be filled with a mortar composed of one part Portland cement and two parts fine aggregate.

- END OF SECTION -

SECTION 02761 - PAVEMENT MARKING

PART 1 GENERAL

1.1 STANDARD SPECIFICATIONS

- A. Replace all pavement markings damaged by construction activities.
- B. When referenced in this section, shall mean Florida Department of Transportation, Standard Specifications for Road and Bridge Construction, current edition.

1.2 DELIVER, STORAGE, AND PROTECTION

- A. Packaging and Labeling: All coatings and traffic marking materials shall be shipped in strong containers plainly marked with the weight in pounds per gallon, the volume of coatings and traffic marking materials content in gallons, the color, user information, date of manufacture, LOT, batch and DOT code number. Each batch manufactured shall have a unique number. A true statement of the percentage composition of the pigment, the proportion of pigment to vehicle, and the name and address of the manufacturer, also shall be shown. The label shall warn the user of any special handling or precautions of the material, as recommended by the manufacturer. Any package not so marked will not be accepted for use under these Specifications.
- B. Storage: Any coatings and traffic marking materials which, although inspected and approved at the point of manufacture, hardens or livers in the containers so that it cannot be readily broken up with a paddle to a smooth, uniform painting consistency, will be rejected. All materials shall have a container storage life of one year from date of manufacture. Any coatings and traffic marking materials not acceptable for proper application will be rejected, even though it conforms to these Specifications in all other respects.
- C. Mixing: All paints except aluminum shall be delivered to the project completely mixed, and ready to be used without additional oil or thinner. Gasoline shall not be used for thinner under any circumstances.

PART 2 PRODUCTS

2.1 PAINT

- A. Color: White, yellow, or blue traffic paint meeting the requirements of Section 971 of the Standard Specifications.
- B. Homogeneous, easily stirred to smooth consistency, with no hard settlement or other objectionable characteristics during a storage period of 6 months.

2.2 THERMOPLASTIC STRIPING

- A. White or yellow thermoplastic striping material meeting the requirements of Section 711 of the Standard Specifications.

2.3 RAISED REFLECTIVE MARKERS

- A. Metallic or nonmetallic, or prismatic reflector type, of permanent colors retaining color and brightness under action of traffic.
- B. Rounded surfaces presenting a smooth contour to traffic. The minimum area of each reflective face shall be 2-1/2 inches squared.
- C. Marker and adhesive epoxy in accordance with ASTM D4280.

2.4 GLASS SPHERES

- A. Glass spheres shall be of a composition designed to be highly resistant to traffic wear and to the effects of weathering.
- B. In accordance with AASHTO M247, Type I with moisture resistant coating or a formulation specified by the traffic striping material manufacturer.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

- A. Cleaning:
 - 1. Thoroughly clean surfaces to be marked before application of pavement marking material.
 - 2. Remove dust, dirt, and other granular surface deposits by sweeping, blowing with compressed air, rinsing with water or a combination of these methods.
 - 3. Completely remove rubber deposits, surface laitance, existing paint markings, and other coatings adhering to pavement with scrapers, wire brushes, sandblasting, approved chemicals, or mechanical abrasion.
 - 4. Scrub areas of old pavement affected with oil or grease with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinse thoroughly after each application.
 - 5. Surfaces shall be completely free of dry dirt and ice, and dry of water at the time of application of any of the materials specified herein.
 - 6. Oil-Soaked Areas: After cleaning, seal with cut shellac to prevent bleeding through the new paint.
 - 7. Reclean surfaces when Work has been stopped due to rain.
 - 8. Existing Pavement Markings:
 - a. Remove existing pavement markings that may interfere or conflict with newly applied marking patterns, or that may result in a misleading or confusing traffic pattern.
 - b. Do not apply thermoplastic markings over existing preformed or thermoplastic markings.

- c. Perform grinding, scraping, sandblasting or other operations so finished pavement surface is not damaged.
- B. Pretreatment for Early Painting: Where early painting is required on rigid pavements, pretreat with an aqueous solution containing 3 percent phosphoric acid and 2 percent zinc chloride.
- C. New Concrete Pavement:
 - 1. Allow a minimum cure time of 30 days before cleaning and marking.
 - 2. Clean by either sandblasting or water blasting to the following results:
 - a. No visible evidence of curing compound on peaks of textured concrete surface.
 - b. No heavy puddled deposits of curing compound in valleys of textured concrete surface.
 - c. Remaining curing compound is intact, with loose and flaking material completely removed.
 - d. Peaks of textured pavement surface are rounded in profile and free of sharp edges and irregularities.
 - 3. Allow a minimum drying time of 24 hours after water blasting before applying thermoplastic markings.

3.2 ALIGNMENT FOR MARKINGS

- A. The CONTRACTOR shall be responsible for all measurements, reference points and marks, string lining, and any other steps required in establishing pavement marking locations and alignment. On tangents and on curves up to 1 degree, the alignment of the marking shall not deviate from the string line by more than 1 inch. On curves exceeding 1 degree, the maximum permissible deviation shall be 2 inches. All alignment width and location shall conform to the details shown on the Drawings.

3.3 PAINT APPLICATION

- A. General:
 - 1. Thoroughly mix pigment and vehicle together prior to application, and keep thoroughly agitated during application.
 - 2. Do not add thinner.
 - 3. Apply only when air and pavement temperatures are above 40 degrees F and less than 95 degrees F. Maintain paint temperature within these same limits.
 - 4. Apply only when surface is dry.
 - 5. Do not apply when conditions are windy to the point of causing overspray or fuzzy line edges.
 - 6. New Asphalt Pavement: Allow a minimum pavement cure time as recommended by the manufacturer before applying paint.

7. Provide guide lines and templates to control paint application.
8. Take special precautions in marking numbers, letters, and symbols.
9. Sharply outline edges of markings and apply without running or spattering.

B. Rate of Application:

1. Reflective Markings:
 - a. Paint: Apply evenly, 105 plus or minus 5 square feet per gallon.
 - b. Glass Beads: Apply uniformly, 6 plus or minus 0.5 pounds of glass spheres per gallon of paint.
2. Nonreflective Markings: Apply paint evenly to pavement surface at a rate of 105 plus or minus 5 square feet per gallon.
3. On new pavement or new asphalt surface treatments, apply two coats of paint at a uniform rate of 210 square feet per gallon.

C. Drying:

1. Provide maximum drying time to prevent undue softening of bitumen and pickup, displacement, or discoloration by traffic.
2. If drying is abnormally slow, discontinue painting operations until cause is determined and corrected.

3.4 THERMOPLASTIC MARKING APPLICATION

- A. Following specified surface preparation, prime and apply marking and glass beads to provide a reflectorized strip as shown on Drawings.
- B. The material shall be applied to the pavement by the extrusion method only, wherein one side of extrusion shaping die is the pavement and the other sides are formed by suitable equipment for heating and controlling the flow of the material.
- C. Application Temperatures:
 1. Pavement Surface: Minimum 40 degrees F and rising.
 2. Thermoplastic: Minimum 375 degrees F, maximum 425 degrees F.
- D. Primer:
 1. On portland cement concrete and existing asphalt pavements, apply epoxy resin primer/sealer according to the thermoplastic manufacturer's recommendations.
 2. All primer/sealer to dry prior to applying thermoplastic.
- E. Thermoplastic Marking:

1. Extrude in a molten state, free of dirt or tint. at a minimum thickness of 0.90 inch for lane lines and 0.125 inch; maximum thickness of 0.190 inch.
 2. Apply centerline, skipline, edgeline, and other longitudinal type markings with a mobile applicator.
 3. Apply special markings, crosswalks, stop bars, legends, arrows, and similar patterns with a portable, extrusion-type applicator.
- F. Glass Bead Application:
1. Immediately after marker application, mechanically apply such that the beads are held by and imbedded in the surface of the molten material.
 2. Application Rate: One pound per 20 square feet of compound.
- G. Cool completed marking to ambient temperature prior to allowing vehicular traffic.

3.5 INSTALLATION OF RAISED REFLECTIVE MARKERS

- A. Apply markers to the bonding surface using bituminous adhesives only.
- B. Apply the adhesive to the binding surface (not the marker) so that 100 percent of the bonding area of the marker will be covered.
- C. Align markers carefully, projecting no more than 3/4-inch above level of pavement. Reflective face of the marker shall be perpendicular to a line parallel to the roadway centerline. Do not install markers over longitudinal or transverse joints of the bonding surface.
- D. Spacing: As shown on the Drawings.
- E. Immediately remove excess adhesive from the bonding surface and exposed surface of the marker.
- F. Use only a mineral spirits meeting Federal Specifications TT-T-291 to remove adhesive from exposed faces of markers.

3.6 GLASS BEAD APPLICATION

- A. Apply immediately following application of paint.
- B. Use evenly distributed, drop-on application method.
- C. Rate: 10 pounds per gallon of paint.

3.7 PROTECTION

- A. The CONTRACTOR shall erect adequate warning signs and/or provide sufficient number of flagmen, and take all necessary precautions for the protection of the materials and safety of the public.
- B. Protect surfaces from disfiguration by paint spatters, splashes, spills, or drips.

3.8 CLEANUP

- A. Remove paint spatters, splashes, spills, or drips from Work and staging areas and areas outside of the immediate Work area where spills occur.

END OF SECTION

SECTION 02820 – ORNAMENTAL FENCING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Furnish all labor and materials required for a complete installation of a ornamental metal fence and gate as described herein and shown on the Drawings.
- B. The manufacturer shall design the fencing (and associated posts) and gates to be removable to facilitate access to the site for maintenance.

1.02 SUBMITTALS

- A. Shop Drawings: Submit shop drawings for the fence in accordance with the Section entitled "Submittals". The shop drawings shall include the following:
 - 1. Shop drawings shall be drawn to scale on 22-inch by 34-inch paper.
 - 2. Plan view showing the affected fencing area with a 20-ft additional perimeter on either side illustrating existing to new fence transition and associated gate with applicable dimensions.
 - 3. Details of the proposed fence to match the existing perimeter fence that is to remain.
 - 4. Details of the fence posts.
 - 5. Details of all accessories required for a complete installation.
 - 6. Finishes.
 - 7. Product Data: Include with the shop drawings, the manufacturer's catalogue cuts indicating material compliance and specified options.

1.03 WARRANTY

- A. Provide manufacturer's standard warranty that its ornamental fence and gate system is free from defects in material and workmanship including cracking, peeling, blistering and corroding for a period of 15 years from the date of purchase.

PART 2 -- PRODUCTS

2.01 MANUFACTURER OR EQUAL

- A. Master Halco, Inc.

2.02 HEIGHT

- A. Fence: Nominal fence panel height shall be 7'-0" unless indicated otherwise on the Drawings.
- B. Gate: Nominal gate panel height shall be 7'-0" unless indicated otherwise on the Drawings.

2.03 ORNAMENTAL PICKET FENCE

- A. Style: Monumental Iron Works, Estate Fence, Style L by Master Halco.
- B. Materials: posts, pickets, rails and all accessories shall be fabricated from steel. Aluminum shall not be accepted.
- C. Fence Panel Length: The nominal panel lengths shall be as indicated on the Drawings.

- D. Picket Fabrication: Galvanized square steel tubular members manufactured per ASTM A-924/A-924M, having a 45,000 psi yield strength and hot-dip galvanized per ASTM A653/A653M with a G90 zinc coating, 0.90 ounce per square foot.
- E. Picket Size: ¾-inch square, 14-gauge.
- F. Picket Spacing: Picket spacing shall be 3 15/16 inches. Pickets shall be attached to rails at the factory using industrial drive rivets.
- G. Rail Fabrication: Galvanized steel "U" channel per ASTM A-653/A-653M, having a 50,000 psi yield strength and G90 zinc coating, 0.90 oz/ft².
- H. Rails: As indicated on the drawings.
- I. Posts: Galvanized square steel tubular members manufactured per ASTM A-653/A-653M having a 45,000 psi yield strength and G90 zinc coating, 0.90 ounce per square foot. Posts shall be coated with zinc on the inside and outside. Posts that are zinc coated on the outside and painted on the inside are unacceptable.
- J. Post Sizes: Fence posts and gate posts shall be a minimum of 3-inch square 12-gauge.
- K. Post Caps: All posts shall be furnished with post caps. The post caps shall be fabricated from formed steel or cast of malleable iron. The caps shall form a weather tight closure. Post caps shall flat style.
- L. Picket Tops: Flat top with polymer plug.
- M. Post Bases: The base of all fence and gate posts shall be a 6-inch square ¼-inch thick steel pre-drilled plate that is factory welded to the post.

2.04 ORNAMENTAL SWING GATE

- A. Style: Monumental Iron Works, Estate Fence, Style L by Master Halco.
- B. Leaf Type: single leaf (unless indicated otherwise on the Drawings).
- C. Materials: posts, pickets, rails and hardware shall be fabricated from galvanized steel. Aluminum shall not be accepted.
- D. Swing gates shall be fabricated using channel rail, gate ends, gussets and pickets. Gates that exceed 6' in width will have intermediate upright(s) and cable trussing with turnbuckle and stiffeners as recommended by the manufacturer.
- E. All rail and upright intersections shall be joined by welding. All picket and rail intersections shall also be joined by welding.
- F. Latch: Capable of retaining gate in closed position and have provision for padlock.

2.05 FINISHES

- A. General: All pickets, rails, posts, fittings, gates and accessories shall be polyester powder coated individually after drilling and layout. Coating of assembled sections is unacceptable.
- B. Surface Preparation: All ferrous components shall be given a 4-stage "Power Wash" pre-treatment process that cleans and prepares the galvanized surface to assure complete adhesion of the finish coat.
- C. Coating Application: Apply polyester resin based powder coating via electrostatic spray process. Minimum coating thickness shall be 2.5 mils.

- D. Cure: The finish shall be cured in a 450 degree Fahrenheit (metal temperature) oven for 20 minutes.
- E. Color: Black.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify areas to receive fencing are completed to final grades and elevations.
- B. Ensure property lines and legal boundaries of work are clearly established.

3.02 REMOVABLE POST INSTALLATION

- A. Posts shall be installed as described herein and the in accordance with manufacturer's instructions.
- B. Post base plates shall be set in grout and anchored as indicated in the Drawings. Anchor bolts and grout shall be furnished and installed by the Contractor.
- C. Check each post for vertical and top alignment, and maintain in position during placement and finishing operation.
- D. Align fence panels between posts. Firmly attach rail brackets to posts with bolt and lock nut, ensuring panels and posts remain plumb.

3.03 GATE INSTALLATION

- A. Install gates plumb, level, and secure for full opening without interference.
- B. Attach hardware by means that will prevent unauthorized removal.
- C. Adjust hardware for smooth operation.

3.04 CLEANING

- A. Clean up debris and unused material, and remove from site.

3.05 SEALING EXPOSED SURFACES

- A. To seal the exposed steel surfaces when cutting/drilling rails or posts, the following steps shall be performed:
 - 1. Remove all metal shavings from cut area.
 - 2. Apply zinc-rich primer to thoroughly cover cut edge and/or drilled hole; let dry.
 - 3. Apply 2 coats of custom finish paint matching fence color.
 - 4. Failure to seal exposed surfaces per steps 1-3 above will negate warranty.
 - 5. Ameristar spray cans or paint pens shall be used to prime and finish exposed surfaces; it is recommended that paint pens be used to prevent overspray. Use of non-Master Halco parts or components will negate the manufacturers' warranty.

3.05 GATE INSTALLATION

- A. Gate posts shall be spaced according to the manufacturers' gate drawings, dependent on standard out-to-out gate leaf dimensions and gate hardware selected.

- B. Type and quantity of gate hinges shall be based on the application; weight, height, and number of gate cycles.
- C. The manufacturers' gate drawings shall identify the necessary gate hardware required for the application.
- D. Gate hardware shall be provided by the manufacture of the gate and shall be installed per manufacturer's recommendations.

-- END OF SECTION --

SECTION 02832 - TEMPORARY CONSTRUCTION FENCE

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Furnish and install temporary chain link fencing, posts, gates, etc. at the staging area where shown on the Drawings and/or where required to secure CONTRACTOR's work site.
- B. If temporary chain construction fence is not shown on the drawings, furnish and install temporary construction fence where agreed upon with OWNER.

1.02 PERMITS

- A. Obtain permits as required by local jurisdiction.

PART 2 -- PRODUCTS

2.01 TEMPORARY CONSTRUCTION FENCE

- A. Type: Chain link, galvanized.
- B. Height: 8'-0".
- C. Gates: Provide gates of the size and location as determined by the CONTRACTOR to be needed.
- D. Lock and Chain: Provide locks and chains as required to secure gate(s).
- E. Windscreen: Provide fence with windscreen for privacy.
- F. Supplier or Equal: National Construction Rentals, Inc.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. Install per supplier's instructions.

- END OF SECTION -

SECTION 02850

WELL MOBILIZATION AND CLEANUP

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. This Section covers the work necessary to move in and move out personnel and equipment, set up and remove drill rigs and temporary facilities, and clean up site, complete.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION

3.01 GENERAL

- A. Set up well drilling equipment within the area designated by the Engineer. Accomplish all required work in accordance with applicable portions of these Specifications.
- B. Some obstructions may not be shown. The removal and replacement of minor obstructions such as electrical conduits, water, waste piping, and similar items shall be anticipated and accomplished, even though not shown or specifically mentioned.
- C. The Contractor shall be responsible for grading within the actual well construction and staging areas to facilitate operations.
- D. The Contractor shall fill and grade land surfaces at each drilling location such that runoff is directed away from the well sites.

3.02 CONTAMINATION PRECAUTIONS

- A. Avoid contamination of the project area. Do not dump waste oil, rubbish, or other similar materials on the ground.

3.03 WELL DRILLER LOG

- A. The Contractor shall maintain a detailed daily log of his operations on each rig during the construction and testing of the wells. The logs shall be on IADC Forms and shall give a complete description of equipment used, fluid and water-level changes and the depths at which they occurred, gravel and cementing operations, repair time and other such pertinent data as may be required by the Engineer. One copy of each daily log shall be submitted to the Engineer on a daily basis.

3.04 CLEANUP OF CONSTRUCTION AREAS

- A. Upon completion and acceptance of each well, remove from the site the drill rig and equipment, complete, and all debris, unused materials, and other miscellaneous items resulting from or used in the operations. All drilling fluids and drill cuttings shall be removed from the work sites. Replace or repair any facility which has been damaged during the construction work. Restore the site as nearly as possible to its original condition.
- B All improved areas disturbed by well construction shall be restored to a condition at least equal to the pre-construction conditions including, but not limited to, all driveways, roads, fences and other improvements. The Contractor shall maintain a photographic record of pre and post-construction conditions at the work sites to substantiate any claims for pre-existing damage.

- END OF SECTION -

SECTION 02851 -- DRILLING

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall provide the work, materials, and equipment necessary for drilling of the wells, complete.
- B. Requirements will be set forth in these specifications regarding the handling of drilling fluids and cuttings. The anticipated well casing and open hole depths listed in the following specifications are approximate. Actual depths may vary depending on specific conditions encountered during well construction. Additionally, the well testing procedures may be changed in order of occurrence, added to, or deleted at the discretion of the Engineer.
- C. At the completion of drilling, the Contractor shall remove the closed circulation system and its appurtenances that are not part of each completed well and leave each site in good condition acceptable to the Engineer.

1.02 CONTRACTOR'S RESPONSIBILITY

- A. All work shall be performed by a certified water well driller, licensed by the State of Florida.
- B. CONTRACTOR shall be responsible for obtaining all necessary local, state and agency permits and completion of summary reports.

1.03 WELL DRILLER QUALIFICATIONS

- A. General: For a Bidder to be eligible for this project, its team must include a water well driller that meets the qualification listed herein.
- B. Water Well Contractor License: The water well driller shall have an active Water Well Contractor License issued by the State of Florida through the South Florida Water Management District. The Bidder shall include a copy of its Water Well Contractor License with its bid.
- C. Bidder Certification: By submitting its bid, the Bidder certifies that the person holding the Water Well Contractor License submitted with the bid will directly oversee the construction of the well. The person holding the Water Well Contractor License shall provide periodic on-site to assure compliance with these specification and applicable regulations.
- D. Experience Documentation: The person with the Water Well Contractor License submitted with the Bid shall have a documented performance record to perform the size and type of work specified in the drilling specifications and indicated on the Drawings. The bidder shall include with its bid, completed forms (included in the Invitation to Bid) that document that the person with the Water Well Contractor License has the following minimum experience:
 - 1. Must have successfully completed ten water supply wells within Palm Beach, Broward or Miami-Dade Counties in the last fifteen years.

1.04 SUBMITTALS

- A. General: Submit information as specified herein in accordance with the Section entitled "Submittals".
- B. Disposal Site Notification: Drill cuttings and fluids from mud-rotary drilling shall be removed from each drilling site and disposed of at a suitable disposal site in accordance with Federal, State, county and local regulations. Prior to mobilizing on site, provide an original letter showing acceptance of above materials by the landfill or other disposal location. The letter shall include the name and location of the disposal site along with documentation that the site has been approved by the appropriate regulatory agencies. Provide the engineer with a map illustrating the location of the disposal site. Provide contact information for the operator of the disposal site.
- C. Shop Drawing: Submit shop drawings documenting the types of drilling fluid or fluid additives proposed for use.
- D. Drilling Mud Removal Plan: At the pre-construction meeting submit a plan to contain and remove all cuttings and drilling mud.
- E. Fluid Disposal Plan: The Contractor shall be responsible for disposal of all fluids produced during drilling, pumping tests and well development. Submit a written plan for disposal at the preconstruction meeting for review by the Engineer.
- F. Well Drilling Notification: For each well location, notify the Engineer in writing (by facsimile and follow-up mailed letter) at least five days (Saturdays, Sundays and holidays excepted) prior to the commencement of drilling.
- G. Daily Reports: The Contractor shall submit to the Engineer a daily drilling report describing the activities performed during the referenced period.
- H. Final Well Log: For each well location, submit a final well log at the completion of the well construction.

1.05 LOCAL GEOLOGIC CONDITIONS

- A. It is anticipated that the boreholes will encounter beds of limestone, sandstone clay and varying amounts of unconsolidated shell and sand. Permeable zones will be present.
- B. Information regarding subsurface conditions is intended to assist the Contractor in establishing a price for the Work. The OWNER does not guarantee its accuracy or that it is necessarily indicative of conditions to be encountered in drilling the wells. The Contractor shall satisfy himself regarding all local conditions affecting his work by personal investigation and neither the information on local geology, nor that derived from maps or plans nor from the Owner or his agents or employees shall act to relieve the Contractor of any responsibility hereunder or from fulfilling any and all of the terms and requirements of the Contract Documents.

1.06 REMEDIAL WORK

- A. If remedial work proves to be necessary to make a well acceptable and come within the governing regulations and/or Contract Documents because of accident, loss of tools,

defective material of for any other cause, the Contractor shall propose a method of correcting the problem, in writing. Suggested methods shall be reviewed and accepted by the ENGINEER before work proceeds. Such work shall be performed at no additional cost to the OWNER and it shall not extend the length of the Contract. The Contractor is notified that all requirements of the Contract Documents shall be met, including hole straightness and setting of casings to the points designated by the Engineer.

1.07 ABANDONMENT OF WELL BY CONTRACTOR

- A. Any hole in which the Contractor voluntarily stops work and/or fails to complete in a satisfactory manner, in accordance with the governing regulations and/or Contract Documents shall be considered as abandoned by him. If the Owner declares the hole abandoned by the Contractor, then no payment will be made for the abandoned hole. All abandoned holes shall be properly plugged and sealed by the Contractor at his own cost in accordance with federal, state and local regulations. All salvageable material furnished by the Contractor may be removed and remain his property. The Contractor shall submit, in writing, his plan of action of abandonment and plugging. Casings may be removed only with the permission and acceptance of the Engineer.

1.08 GUARANTEE

- A. The Contractor guarantees that the work and service to be performed, under the Contract and all workmanship, materials and equipment performed, furnished, used or installed in the work shall be free from defects and flaws, and shall be performed and furnished in strict accordance with the Contract Documents; that the strength of all parts of all manufactured equipment shall be adequate and as specified; and that performance test requirements of the Contract Documents shall be fulfilled. The Contractor shall repair, correct, or replace all damage to the work resulting from failures covered by the guarantee. The guarantee shall remain in effect for one year from the date of final acceptance by the Owner.

1.09 STANDBY TIME

- A. The Engineer may order the Contractor to stop his operations so that extra work not included in the Contract Documents such as testing and additional data collection can be performed. The Engineer will advise the Contractor when he proposes to do this and will schedule his request so it causes a minimum of delay. All extra work must be accepted by the Owner in writing, in advance.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION

3.01 EQUIPMENT

- A. The Contractor shall provide all necessary equipment to perform specified work. The Contractor and/or his subcontractor's equipment shall be in first class working order and shall be suitable for completing work described herein. No unnecessary delays or work stoppages will be tolerated because of equipment failure. They will not be considered a valid reason for extending the length of the Contract. The Contractor shall be held

responsible and payment may be withheld for damages to a well due to any cause of negligence, faulty operation, or equipment failure.

- B. The Contractor shall provide and operate equipment capable of handling the largest load that will be placed upon the rigs drilling and supporting equipment. If conditions develop in the field that prove the rigs and supporting equipment that had been supplied by the Contractor are incapable of completing a well, the Contractor shall provide a larger rig with the necessary capacity at his own cost.
- C. The Contractor and/or his subcontractor's equipment shall be operated and maintained in conformance with manufacturer's recommendations.
- D. The Contractor shall provide all drilling fluids, water, and additives required for drilling. All fluids and additives shall comply with Federal, State and Local regulations. The Contractor shall review fluids and additives with the Engineer prior to drilling.
- E. The Contractor shall use only potable water for makeup of drilling fluids and grout preparation. It shall be the Contractor's responsibility to coordinate potable water use in accordance with the requirements in Section 01510 "TEMPORARY UTILITIES".
- F. The Contractor shall provide equipment for measuring weight and viscosity of drilling fluid.
- G. The Contractor shall provide sampling bags or containers as acceptable to the Engineer.
- H. The Contractor shall provide water sampling containers as acceptable to the Engineer.

3.02 DRILLING

- A. Pilot hole drilling and reaming shall be conducted by either the mud-rotary or the reverse-air circulation method. The reverse-air method shall be used for all open hole drilling, except in limited cases where formation yields are inadequate and an external source of potable water is required to properly clean the borehole. Potable water shall not be used for open hole drilling without prior acceptance by the Engineer.
- B. Fluid for mud-rotary circulation shall be a mixture of potable water and high-grade bentonite unless other types of drilling fluid or fluid additives have been approved in advance by the Engineer. All drilling additives must be approved for use in public supply wells by NSF. Drilling mud shall be conditioned using a shale shaker and desanders, or other equipment acceptable to the Engineer prior to being recirculated into the borehole.
- C. Drill cuttings and fluids from mud-rotary drilling shall be removed from each drilling site and disposed of at a suitable location. The Contractor shall furnish the Engineer and Owner prior to beginning construction, the name and location of his disposal site along with documentation that the site has been approved by the appropriate regulatory agencies. The fluid displaced from the borehole during cementing operations shall be considered excess drilling fluid and shall be disposed of in the accepted manner.
- D. Lost circulation conditions may be encountered while drilling with mud. The use of lost circulation materials shall be restricted to those materials approved by FDEP and NSF.
- E. At all times during the progress of the work the Contractor shall use reasonable precautions to prevent either tampering with the well or the entrance of foreign material into it.

- F. At the completion of drilling, the Contractor shall remove the closed circulation system and its appurtenances that are not part of each completed well and leave each site in good condition acceptable to the Engineer.
- G. When all casings are being set and cemented in place, it is the Contractor's responsibility to insure that these operations are conducted in such a manner that the casing collapse and burst strengths (with safety factor) are not exceeded and the casings are not caused to fail.
- H. The Contractor shall notify the Engineer in writing at least five days (Saturdays, Sundays and holidays excepted) prior to the commencement of drilling. The Contractor shall bear all costs associated with special inspections by the Owner or Engineer should he choose to perform work outside regular working hours. Regular working hours are to be defined at the preconstruction meeting and are subject to prior acceptance by the Engineer. Said work shall be coordinated with the Engineer at least five days prior to commencement of work. The Contractor shall maintain appropriate lighting for the different parts of the project as required to comply with applicable Federal, and State regulations and all requirements of the Owner.
- I. The Contractor shall provide a thoroughly experienced, competent, and licensed driller which shall be present onsite during all operations.
- J. Wells are to be of the general type and characteristics described in the Contract Documents. The exact depth of well and length of casings will be determined in the field.
- K. The Contractor shall drill the wells at the approximate location shown on the Drawings. The exact location will be determined in the field by the Owner or the Engineer. The Contractor shall provide a surveyor to establish the well location shown on the Drawings.
- L. During reaming operations the Contractor shall incorporate the use of a lead bit and a staged drilling assembly to facilitate pilot hole tracking.
- M. The Contractor shall drill all boreholes straight and plumb to permit the installation of the casing.

3.03 ALIGNMENT

- A. The Contractor is responsible for plumbness of the borehole. Requirements for testing plumbness are specified in the Section entitled "CASING".
- B. All pilot holes and boreholes shall be drilled round, plumb, and straight throughout.

3.04 DATA COLLECTION

- A. The Contractor shall be responsible for collection of formation samples. Each sample shall be approximately one pint in volume, and placed in a container labeled using indelible ink with the date, well identification, and depth from which the sample was taken. Sampling and labeling procedures shall be in accordance with Bulletin No. 638-S, Instructions for Taking Formation Samples, published by UOP-Johnson Division, and also in accordance with the instructions for collecting samples given in the Department of the Army's Technical Manual TM5-297, Wells.

- B. The Contractor shall collect two sets of formation samples from the well at intervals of 5 feet and at every formation change and drilling break. The samples shall be preserved in cloth sample bags to be furnished by the Contractor. The sample containers shall be plainly marked with the well identification and shall show the depth below the ground surface from which they were taken. The Contractor shall collect the samples, provide suitable facilities for storage while they remain onsite and deliver them to the Engineer.

3.05 WATER SAMPLING DURING AIR DEVELOPMENT

- A. See the Specification titled "Well Development".

3.06 RECORD KEEPING

- A. The Contractor shall submit to the Engineer a daily drilling report describing the activities performed during the referenced period. Original daily logs shall be submitted with 48 hours of occurrence. The log shall accurately describe the geologic materials and depths encountered, the presence or absence of water, depths of lost circulation zones and methods of regaining circulation, drilling rates, time and description of any unusual occurrences or problems during drilling, diameters and lengths of casing installed cementing operations, repair time and other such pertinent data as may be required by the Engineer. The Contractor shall also provide a tabulation of all quantities for pay items and a description of all decisions made by the Contractor.
- B. The Contractor shall maintain a detailed daily log of his operations on each rig during the construction of each well. The logs shall be on IADC Forms and shall give a complete description of all formations encountered, footage and size of hole drilled, depth and sizes of all casings installed in the well, fluid losses, complete record of drilling fluids added, water-level changes and the depths at which they occurred, repair time and other such pertinent data as may be required by the Engineer. One copy of each daily log shall be submitted to the Engineer on a daily basis.
- C. The Contractor shall keep a copy of the daily log at the drill site for inspection at all times. Failure to keep this record up-to-date (maximum 48 hours from occurrence) shall be grounds for the Engineer to stop drilling operations.
- D. The Contractor shall prepare and submit to the Engineer a final well log which shall include geologic log, borehole diameters, depth to the bottom of casing and/or the bottom of the borehole, casing diameters and wall thickness, cemented zones, perforated or screened interval(s) type, size and quantity of gravel pack installed, amount of sand removed during development and other information from the daily logs pertinent to the well construction. In addition the Contractor shall file all records and reports with the proper agencies required by Federal, State and local codes or regulations.

3.07 REGULATORY COMPLIANCE

- A. The Contractor shall construct the wells in conformance with all laws, rules, regulations and standards related to the construction of wells in the United States, State of Florida, Broward County, South Florida Water Management District, and any other applicable regulations.
- B. The Contractor shall take all necessary precautions to prevent contaminated water, gasoline, or other deleterious substances from entering the well, either through the opening

or by seepage through the ground surface. Maintain precautions during and after construction of the well until accepted by the Owner.

- C. The Contractor shall be responsible for disposal of cuttings and water, and shall make arrangements to remove all drilling fluids and cuttings from the site in accordance with Federal, State, county and local regulations. The Contractor shall provide the Engineer with an original letter showing acceptance of above materials by the landfill or other disposal location prior to construction. The letter shall include the name and location of the disposal site along with documentation that the site has been approved by the appropriate regulatory agencies. The fluids displaced from the borehole during cementing operations shall be considered excess drilling fluids and shall be disposed of in an acceptable manner. The Contractor shall submit a plan to contain and remove all cuttings and drilling mud for the Owner's acceptance at the preconstruction meeting.

3.08 DRILLING PAD

- A. The Contractor shall fill and grade the drilling locations such that runoff is directed away from the well sites.

3.09 CONDITIONS AND HAZARDS

- A. The Contractor should be advised and be aware of difficult drilling conditions and problems he may encounter during the drilling, construction, and testing of the wells. Typical examples he may have to cope with include, but are not limited to, lost circulation, cavities and fractured zones; squeezing zones and potential sand intervals, with attendant caving problems. A priority requirement of these Technical Specifications is the drilling of straight holes and setting all casing to specified depths. Hole straightness, which will permit casings to be set at specified depths and facilitate achievement of proper cement seals, shall not be sacrificed for drilling speed. These and other pertinent factors shall be taken into consideration by the Contractor in planning and executing the work.
- B. The goal of this program is the successful completion of the wells described in these Contract Documents. In the event of any problems or difficulty which, in the Engineer's opinion, may jeopardize the successful completion of a well in accordance with the governing regulations, Contract Documents and approved changes, it is the Contractor's responsibility to perform work required to successfully remedy any problem and perform such surveys and testing as necessary to demonstrate the problem has been solved and that the wells are in compliance with the Contract Documents. The Contractor shall bear all costs of testing, surveys and work deemed necessary by the Engineer to confirm that the problem has been resolved or corrected and that the construction is in compliance with the Technical Specifications and appropriate governing regulations. In the event that a problem occurs, the Contractor will be notified in writing by the Engineer. The Contractor shall submit to the Engineer his plan of action to identify and/or solve the problem and the Engineer will review the plan of action. In the event the problem is considered serious enough to jeopardize successful completion of the well in accordance with the Contract Documents, the Engineer may request technical concurrence from the regulatory and scientific agencies in accordance with the construction permits. No monies will be paid for the time spent by the Contractor during the entire period of review for the particular problem.
- C. The Engineer will notify the Contractor that:

1. Plan of action is acceptable;
 2. Plan of action is acceptable with Engineer's suggested modifications;
 3. Plan of action is not acceptable.
- D. Under (1.), the Contractor shall proceed with the plan of action. The Contractor shall bear all costs of surveys associated with detecting the problem, implementing his plan of action, and tests to confirm the plan of action was carried to successful completion and to obtain acceptance of the Engineer.
- E. Under (2.), the Contractor shall resubmit his plan of action with necessary backup and justification of revised plan of action. The Engineer shall notify the Contractor that the revised plan of action is (1.) acceptable or (3.) not acceptable.
- F. If the plan of action is not acceptable to the Engineer and the Contractor elects to pursue the unacceptable plan of action, then two options exist for the Engineer.
- G. OPTION A: If the unacceptable plan of action jeopardized the well construction, completion, or operation in the Engineer's opinion and the Contractor elects to implement the unacceptable plan of action, the Engineer may declare the well abandoned by the Contractor. A determination shall be made by the Engineer whether to abandon the well or attempt to correct the existing well. The Contractor shall bear all costs of rig time, etc., from original verbal notification and all cost of either abandoning the well or taking steps to complete a successful well.
- H. OPTION B: If the unacceptable plan of action does not jeopardize the well construction, completion, or operation in the Engineer's opinion, the Contractor may, at his own risk proceed with his plan of action. The Contractor shall bear all cost associated with his plan of action including testing, remedies, surveys, and programs to solve the problem. When completed, the Contractor shall notify the Engineer that the problem has been resolved. The Contractor shall bear all costs of testing, surveys, and work deemed necessary by the Engineer to confirm that the problem has been resolved. If the Engineer is satisfied that the problem has been resolved by the Contractor, then the Contractor shall proceed with the construction of the well, bearing all costs of the plan of action and the Engineer's program to confirm successful completion.
- 3.10 DISPOSAL OF WATER
- A. The Contractor's bid for disposal of water during well drilling, development and testing shall be based on the Drawing titled "Development Water Disposal Plan", associated permits obtained by the Engineer and included in the bidding documents and the specifications herein.
- B. The Contractor is responsible for disposal of all fluids produced during drilling, pumping tests and well development. The Contractor shall be responsible for all necessary permitting associated with water disposal. The Contractor shall submit a written plan for disposal at the preconstruction meeting for review by the Engineer.
- C. The Contractor shall ensure that his own and other work sites and associated access roads are maintained in a reasonably dry condition so that work activities are not impaired.

- D. Contractor shall coordinate a water disposal plan with the Engineer prior to commencement of testing. As soon as possible after the notice to proceed coordinate a meeting with the ENGINEER and OWNER to discuss the Contractor's sequence of construction and water disposal plan.
- E. Chlorinated water from well disinfection shall be dechlorinated prior to disposal. Provide de-chlorination facilities in accordance with the requirements of State and local regulatory agencies for disposal of water to a surface water body.
- F. Formation fluids from reverse-air drilling, well development and well testing shall be treated to remove suspended solids prior to discharge. Furnish positive treatment means to ensure that suspended solids are removed in accordance with State and local requirements prior to disposal.
- G. It is the Contractor's responsibility to design, permit, furnish and install all temporary piping, valves and accessories to convey water to the disposal location. The Contractor shall ensure that its temporary pipe routing does not block access to properties along the route from the well to the disposal location.
- H. The Contractor shall provide for the disposal of the water in such a manner as shall not cause injury to public health or private property, or to any portion of the work completed or in progress, or to the surface of the streets, existing sanitary or storm sewers, or the surface of private or public property, or to impede the use of the streets by the public.

- END OF SECTION -

SECTION 02852

CASING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall provide all the work, materials, and equipment necessary for furnishing, installing, and testing the straightness and plumbness of the well casing, complete.
- B. The Contractor shall provide all materials and equipment necessary for joining and installing the casing as specified.

1.02 REFERENCE STANDARDS

- | | | |
|----|-------------|--|
| A. | ASTM F480 | Standard Specification for Thermoplastic Well Casing Pipe and Couplings Made in Standard Dimension Ratios (SDR), SCH 40 and SCH 80 |
| B. | ASTM D1784 | Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds |
| C. | ASTM D1785 | Specification for poly (vinyl chloride) (PVC) plastic pipe, Schedule 40, 80, and 120 |
| D. | ASTM D2241 | Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series). |
| D. | NSF/ANSI 14 | Plastics Piping System Components and Related Materials |
| E. | NSF/ANSI 61 | Drinking water system components - health effects |

1.03 SUBMITTALS

- A. Submit shop drawings in accordance with the Section entitled "Submittals". The submittals shall include:
 - 1. Manufacturer's literature for the well casing, centralizers, and primer, welding solvent and solvent cement to be supplied.

2. Manufacturer's instructions for solvent welding the well casing joints.
- B. Submit test results of the straightness and plumbness tests for all wells in accordance with the Section entitled "Submittals".

PART 2 – PRODUCTS

2.01 WELL CASING

- A. Well casing strings shall be Type I, Grade I, Polyvinyl Chloride (PVC) compound with a Cell Classification of 12454 per ASTM D1784. Well casing shall meet the requirements of ASTM F480.
- B. All materials supplied (including casings, couplings, components, and related joining materials, solvents, cements, or primers) under this project shall meet the NSF Standard 61 or the health effects portion of NSF Standard 14. All products must be coded, stamped, marked, or otherwise certified that the materials supplied comply with these standards.
- C. All casing material shall be new and unused.
- D. Nominal Diameters: 24-inch nominal diameter.
- E. Schedule (SCH): Schedule 80.
- F. Minimum Casing Length: Not less than 20-feet.
- G. Markings: Each length of PVC pipe that is used as permanent well casing shall be legibly marked, by the manufacturer, with all of the following information:
 1. The nominal pipe size.
 2. The schedule (SCH).
 3. The type of plastic.
 4. The wording "well casing"
 5. The impact classification (IC).
 6. A designation that the pipe is in compliance with the provisions of ASTM specification F 480
 7. The manufacturer's name or trademark.
 8. The manufacturer's code for resin manufacture.
 9. The lot number and date of manufacture.

10. A certification mark that verifies that the pipe is in compliance with the provisions of ANSI/NSF standard 14 of 61.

- H. Casing Joints: PVC well casing joints shall be deep socket bell ends or couplings that are manufactured in accordance with ASTM specification F 480. Each casing length of 20 feet shall be supplied with a bell end or a coupling.
- I. Primer, Welding Solvent and Solvent Cement: PVC well casing joints shall be formed utilizing a 2-step solvent cementing process that is consistent with the provisions of ASTM specification F 480. The pipe ends shall be free of burrs, dust, or moisture that might interfere with the solvent weld. A primer or welding solvent shall be used before cementing. The primer, welding solvent, and solvent cement shall be compatible with the pipe being coupled and the ambient temperature at the time of use.

2.02 WELL CASING MANUFACTURER

- A. Well casing shall be supplied by GF Piping Systems, or Equal.

2.03 CENTRALIZERS

- A. Well casing centralizers shall be Kwik-Zip HD Series, or Equal.
- B. The number of segments in each spacer shall comply with the manufacturer's recommendations.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. The Contractor shall install casing to the approximate depths as shown in the Drawings. Final casing depth will be determined in the field by the Engineer.
- B. The Contractor shall install the casing such that all joints are watertight. The method used to connect casing lengths shall be in accordance with the manufacturer's recommendations so that the resulting joint shall have the same structural integrity as the casing itself.
- C. Pipe joints shall be connected following the manufactures recommended practices so that the casing string can withstand the tensile load experienced during installation. If screws are used in fastening the casing joints, they shall be installed in a manner that will prevent them from penetrating through the internal surface of the pipe. PVC well casing joints shall be formed utilizing a 2-step solvent cementing process that is consistent with the provisions of ASTM specification F 480. The pipe ends shall be free of burrs, dust, or moisture that might interfere with the solvent weld. A primer or welding solvent shall be used before cementing. The primer, welding solvent, and solvent cement shall be compatible with the pipe being coupled and the ambient temperature at the time of use.

- D. The Contractor shall remove and replace all casing which fails, collapses, or separates during construction at his sole expense.

3.02 PLUMBNESS AND ALIGNMENT

- A. Priority requirements of these Technical Specifications is the drilling of straight holes and casing to the required depths. To ensure that the casing and tubing can be set to the required depths and properly cemented, all holes shall be drilled so that they are straight. Hole straightness, which will allow setting the casing at the required depths and provided room for proper cementing shall not be sacrificed for drilling speed or any other reason.
- B. All holes for all wells shall be round, straight, and true to line. No doglegs or departures from a straight line shall be permitted which will interfere or prevent casings from being set to their required depths.

3.03 ALIGNMENT TEST

- A. To confirm compliance with the Specifications, a hole alignment test shall be performed on the production casing.
- B. Lower a 40-foot long section of pipe (called the "dummy") into each well to a depth of 80-foot below land surface.
- C. The outer diameter of the dummy shall be no smaller than 0.5-inches less the inside diameter of the casing being tested.
- D. The dummy shall pass freely through the well with no binding or obstructions.
- E. The Contractor shall submit to the Engineer a remediation plan for the repair of any well that fails the dummy test. If the well can not be repaired, the well shall be plugged in accordance with current state requirements and a new well constructed at the Contractor's own expense.

3.04 CENTRALIZERS

- A. Centralizers shall be installed in accordance with the Manufacturer's installation guide.
- B. Ensure that the centralizers are in a precise vertical alignment, one above the other, to allow for placement of tremie pipes in the annulus.
- C. Casing centralizers shall be installed every five feet.

3.05 CASING PENETRATIONS

- A. Casing shall not be penetrated.

- END OF SECTION -

SECTION 02853

GEOPHYSICAL LOGGING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall provide all work, materials, and equipment necessary to prepare the borehole/well for geophysical logging. The Contractor shall employ the services of a company acceptable to the Engineer to obtain geophysical logs of the injection and monitor wells. The Contractor shall prepare and condition each hole to insure it is open and can be logged with a minimum of delay. The following logs shall be run in the well at the stages listed and their cost shall be included. No payment will be made for logs which are unusable or inaccurate due to poor performance of the logging equipment.
- B. A schedule of the proposed geophysical logs is provided in the Table titled "Geophysical Logging Schedule". Other geophysical logs may be required and/or selected by the Engineer.
- C. The Contractor shall assist the Engineer during geophysical logging and data collection as needed.
- D. The Contractor shall be responsible for the preparation of the borehole/pilot hole for geophysical logging.

1.02 SUBMITTALS

- A. Geophysical Logs – Field Copies: Furnish three printed field copies of the various logs to the Engineer and shall provide them within three hours of the time when logging was complete. A written field evaluation of their quality shall be submitted within two days of completion.
- B. Geophysical Logs – Digital Copies: A digital version of the geophysical logs shall be submitted in accordance with the requirements of the Section titled "Submittals".
- C. Calibration Certificates: Submit calibration certificates for flow meters in accordance with the requirements of the Section titled "Submittals"..

1.02 NOTIFICATIONS

- A. Notify the Engineer in writing and by phone 36-hours in advance (exclusive of Saturdays, Sundays and holidays) prior to any testing and/or geophysical logging.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION

3.01 LOGGING

- A. Geophysical logging shall be done as soon as possible after drilling and preparation of the pilot hole or borehole. Caliper and natural gamma ray logs shall be run over the entire open hole and casing. Tools run for the other logs shall be run over the entire open borehole and the lower 75 feet of casing. Caliper logs shall be performed with a four-arm (x-y) tool. The Contractor shall notify the Engineer 36 hours in advance of any scheduled logging event.
- B. The pilot holes and the wells shall be logged in stages as indicated in the "Geophysical Logging Schedule".
- C. The Contractor shall be responsible for preparing the open hole intervals for geophysical logging by removing all drill cuttings from the hole and by properly conditioning the well bore to prevent the formation from collapsing into the hole. The Contractor shall be responsible for keeping the borehole open and free from obstruction during geophysical logging and shall remove any obstruction to the logging tools at his own expense. In the event that the logging tools do not reach to within five feet of the bottom of the hole, as measured by the length of the drill pipe, the Contractor shall then clean the hole to the original drilled depth at his own expense. The logs shall then be rerun at the Contractor's expense.
- D. Flow velocity, fluid conductivity, and temperature logs shall be performed under static and dynamic conditions. The Contractor shall furnish and install a pumping system capable of maintaining a constant withdrawal of at least 850 gallons per minute (gpm) for the production wells. Discharge rates shall be measured using an approved metering device (calibrated flow meter or orifice plate) furnished by the Contractor. Calibration certificates shall be submitted to the Engineer prior to installation of the pumping system.
- E. Dynamic flow logs shall be recorded down hole after static runs have been completed with the well shut in to establish rotor counts due to tool motion. Recorded static counts shall be displayed on the same track as the dynamic flow log, with counts attributed solely to well flow clearly distinguished. A separate tool run shall be performed in which flow velocity is recorded at up to 15 fixed stations in each well as selected by the Engineer. For each dynamic flow log, the Contractor shall provide a separate record that displays the percent fluid flow versus tool depth, calculated from the calibrated flow log results and the cross-sectional area of the borehole as indicated by the caliper log.
- F. The Contractor shall provide access down the well for data collection and geophysical logging during pumping tests. If needed, pumps shall be capable of being removed and reinstalled to facilitate logging.
- G. The Engineer may need to perform work of an experimental nature or consult with regulatory agencies which will require the Contractor to stop drilling operations. During such time it may be necessary for the drilling crew and equipment to standby during normal working hours. In such an event the representative of the Engineer shall order the Contractor to cease operations and will state the anticipated duration of the standby

period. The start and stop of standby time is to be recorded on the daily logs maintained by both the Contractor's superintendent and the Engineer's representative. In the event of disagreement, payment for standby time will be based upon the records maintained by the Engineer's representative.

- H. The Contractor shall be responsible for performing all work as expeditiously as possible. Undue delays may result in payment by the Contractor for Engineer's time. The Owner and the Engineer must be given 36 hours written notice (exclusive of Saturdays, Sundays and holidays) prior to any testing, geophysical logging, or grouting. Payment to the Contractor for standby time shall commence at the end of the 36-hour notice period, as long as such time is within normal working hours. Approval for any standby time to be paid to the Contractor shall be made in writing within 48 hours of occurrence to be considered for approval by the Engineer. If the Owner and the Engineer are notified to be onsite for testing, geophysical logging, pumping tests, or cementing and the Contractor is not ready, then the Owner shall be reimbursed for the Engineer's time.

3.02 GEOPHYSICAL LOGGING SCHEDULE

- A. A schedule of geophysical logs is presented below.

Geophysical Logging Schedule

Construction Phase	Approximate Depth Below Land Surface	Geophysical Logs
8-inch pilot hole	0-80	Caliper and gamma ray
32-inch reamed hole	0-80	Caliper
24-inch reamed hole	80-110 feet	Caliper, gamma ray, dual induction, and under static and flowing conditions - temperature, fluid conductivity and flowmeter

- END OF SECTION -

SECTION 02854

GROUTING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Provide the work, materials, and equipment necessary for furnishing and installing the grout seal, complete.

1.02 SUBMITTALS

- A. Cement Mixtures: Submit all cement mixtures to the Engineer prior to placement.
- B. Grouting Plan: Submit a detailed grouting plan in writing (at least 24 hours before grouting starts) prior to each grout operation for review by the Engineer. The grouting plan shall include all calculations in detail showing quantities of grout needed and pressure calculations to avoid casing collapse during grouting. Also include injection pump capacity, equipment used for mixing and grout mix, and monitoring equipment.

PART 2 -- PRODUCTS

2.01 GROUT INFORMATION

- A. Provide all grout, materials, collarless tremie pipe specifications, and equipment necessary for placement of the grout as specified.
- D. Grout shall be neat cement conforming to ASTM C150, type 2. Water shall not be more than six gallons of water per 94 pound of cement. A maximum of six percent (by weight) of bentonite and two percent (by weight) of calcium chloride may be added.
- E. Grout can be used with additives and lost circulation materials (Flocele) as necessary and acceptable to the Engineer. Organic polymers, peanut shells and cotton seed hulls shall not be used as lost circulation materials. All grout mixtures shall be approved by the Engineer in advance of placement. The cost for grout shall include cement and all additives and lost circulation materials.

PART 3 -- EXECUTION

3.01 GROUTING PROCEDURES

- A. General: Grouting (cementing) shall be completed by a company that is expert in well cementing, such as Halliburton Services, unless the Contractor can demonstrate that he has the equipment and expertise to perform these operations. Cementing will be accomplished in stages by mean of a collarless tremie pipe with the exception of the first stage which shall be pressure grouted. After each stage of cementing and before the next stage, the Contractor shall tag the top of the cement with a collarless tremie pipe

and recondition the mud to assure proper mud displacement by the cement. The method of cementing applies to all cementing procedures in all casing.

- B. Cementing procedures shall be continuous for each stage after cementing begins. If loss of circulation or no return of cement is encountered, the Engineer shall be notified immediately of what remedial measures are underway to reestablish the circulation and complete the cementing program according to well design and Technical Specifications.
- C. During the cementing of all strings of casing, the Contractor shall be responsible for having a sample from each cement stage collected (both dry and mixed). Mixed cement sample shall include at least three, 2-inch cubes from each cement stage.
- D. During all stages of cementing, the Contractor shall use a preflush or spacer. The Contractor shall submit the technical specification of the preflush to the Engineer for review before cementing begins.
- E. When the casings are being set and cemented in place, it is the Contractor's responsibility to insure that these operations are conducted in such a manner that the casing collapse and burst strengths (with safety factor) are not exceeded and the casing are not caused to fail. Cement shall be pumped or placed so that excessive pressures will not result and affect the bond.
- F. The Contractor may be required to backplug a portion of the borehole with cement. In such cases, cementing shall be done through a collarless tremi pipe positioned slightly above the bottom of the hole or top of the previous cement stage. A sufficient grout thickness shall be maintained above the discharge point to ensure that the grout mixture is not introduced directly into the water column in the well. The Contractor shall determine the volume of cement that shall be used in each grout stage and the number of stages required to backplug only the portion of the borehole specified by the Engineer.

3.02 GROUT CURING

- A. The Contractor shall allow a minimum grout curing time of at least 12 hours between each grout stage.
- B. The Contractor shall not perform any work or any drilling operations until the grout has cured.
- C. The Contractor shall wait a minimum of 24 hours after the completion of the last grout stage. The well grouted shall be left undisturbed for at least 24 hours for setting of the grout.

- END OF SECTION -

SECTION 02858

PUMPING TESTS AND WATER QUALITY TESTING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Provide the work, materials, and equipment necessary for the well pumping tests, complete. Pumping tests will be constant rate and variable rate (step drawdown) tests.
- B. The length of the pumping tests is estimated to be 4 hours for variable rate pumping tests. However, the duration of each step will be dependent on aquifer response and may range from 30 minutes to 120 minutes. The Engineer shall be the sole judge as to length of the test and therefore may increase or decrease the total pumping time.
- C. Schedule work so that all pumping is conducted during daylight hours.
- D. Retain laboratory certified by the Florida Department of Health to perform sampling and analyses of water quality as required in this specification.

1.02 NOTIFICATIONS

- A. Notify the Engineer in writing 72 hours in advance (exclusive of Saturdays, Sundays and holidays) prior to start of pumping test.
- B. Notify the Engineer by phone 36 hours in advance (exclusive of Saturdays, Sundays and holidays) prior to start of pumping test.

1.03 SUBMITTALS

- A. Flow Meter Calibration Certificates: Discharge rates shall be measured using a metering device (calibrated flow meter or orifice plate) furnished by the Contractor. Calibration certificates shall be submitted to the Engineer prior to the commencement of testing.
- B. Pressure Transducer Calibration Certificates: The Contractor shall be responsible for providing a pressure recording system capable of measuring pressure changes of 0.01 psi to measure the drawdown and recovery due to pumping. A copy of the pressure transducer calibration certificate shall be provided to the Engineer prior to the commencement of testing.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION

3.01 EQUIPMENT

- A. The Contractor shall provide and install a submersible pump in the pumping well capable of pumping 700 to 3,000 gpm at a constant rate.
- B. The Contractor shall provide a gate valve, or equal, on the discharge side of the pump, downstream of the flowmeter for adjustment of flowrate down to the required flow range.
- C. The Contractor shall provide the pumping unit, controls, and appurtenances shall be capable of continuous operation for a period of 4 hours. If equipment fails to operate as specified, the Contractor shall pay for all costs associated with re-running of the test in progress, including Engineer's labor and expenses.
- D. Contractor shall make his own arrangements for power for the well pumping test.
- E. The Contractor shall be responsible for installation and maintenance of the submersible pump, flow measuring device(s), discharge piping, access pipe and other necessary appurtenances shall be installed for the well pumping test.

3.02 FLOW MEASURING DEVICE

- A. The Contractor shall provide a flow-meter with an indicator and a totalizer capable of measuring the pump discharge within plus or minus five percent of true flow for rates between 700 to 3,000 gpm. A copy of the flow-meter calibration certificate shall be provided to the Engineer prior to the commencement of testing.

3.03 WATER LEVEL MEASURING DEVICE

- A. The Contractor shall install a calibrated and accurate water level measuring device. The Contractor shall furnish an electronic water level indicator. A copy of the water level measuring device's calibration certificate shall be provided to the Engineer prior to the commencement of testing.

3.04 STEP-DRAWDOWN PUMPING TEST

- A. The Contractor shall conduct a variable rate (step-drawdown) pumping test. The step drawdown pumping rates and durations shall be approximately as follows:

Step	Flow Rate (gpm)	Duration (min)
1	1,100	60
2	1,650	60
3	2,200	60
4	2,750	60

- B. The following data shall be recorded by the Contractor and submitted as an Excel spreadsheet.

Step	Flow Rate (gpm)	Step Duration (min)	Distance to Water Surface from Top of Pump Pad (ft)	Water Surface Elevation (NAVD 1988)	Drawdown (ft)
0	0	Not Applicable			
1					
2					
3					
4					

- C. If the same pump for the step drawdown test is also used for final well development the time between completing development and imitating the step drawdown test must be sufficient to allow the water level in the well (or shut in pressure) to return to static conditions as determined by the Engineer.

3.05 STEP-DRAWDOWN HYDRAULIC DATA REPORT

- A. The Contractor shall digitally log drawdown and flowrate during the step-drawdown test.
- B. The Contractor shall process the data collected and document the result in a report. The report shall include the following:
1. Narrative description of the project, the well driller, the equipment used to collect the data, the software used to process the data, etc.
 2. Drawdown versus time curve
 3. Transmissivity
 4. Hydraulic conductivity
 5. Linear well head-loss coefficient
 6. Nonlinear well head-loss coefficient
 7. Wellbore skin factor
 8. Aquifer loss
 9. Well efficiency
 10. Effective well radius
- C. The Step-Drawdown data shall be submitted in a report in accordance with the requirements in the section titled "Submittals".

3.06 STEP-DRAWDOWN WATER QUALITY REPORT

- A. The Contractor shall supply field instrumentation and/or laboratory services to collect the data indicated in the table below (for each well); sampling shall be performed at the end of each step. Data shall be submitted as an Excel spreadsheet. The excel spreadsheet to define the instrument used for each parameter and document the most recent calibration along with the name of the person that collected the data.

Step	Flow Rate (gpm)	Drawdown at the End of Each Step (ft)	Conductivity (μS/cm)	Temperature (degree C)	Chloride (mg/L)	Total Dissolved Solids (mg/L)
0	0					
1	1,100					
2	1,650					
3	2,200					
4	2,750					

3.07 DRINKING WATER SAMPLING AND ANALYSES

- A. The Contractor shall retain a lab certified by the state of Florida for primary and secondary drinking water standards, disinfection by-products and PFOA/PFOS.
- B. Field measurements for dissolved oxygen, pH, and turbidity shall be performed following the appropriate procedures in the Florida Department of Environmental Protection Standard Operating Procedures for Field Activities, DEP-SOP-001/01, as incorporated into Rule 62-160.800, Florida Administrative Code (FAC), and all other measurements shall be performed using an appropriate method referenced in subsection 62-550.550(1), FAC, or in *Standard Methods for the Examination of Water and Wastewater* as adopted in Rule 62-555.335, FAC.
- C. At the completion of the step-drawdown test (unless noted otherwise below), sample water for the parameters listed below.
 1. Florida Administrative Code 62-550 – Microbiological Monitoring
 2. Florida Administrative Code 62-550 – Disinfection By-Products
 3. Florida Administrative Code 62-550 – Inorganic Contaminants
 4. Florida Administrative Code 62-550 – Volatile Organic Contaminants
 5. Florida Administrative Code 62-550 – Synthetic Organic Contaminants
 6. Florida Administrative Code 62-550 – Radionuclides
 7. Florida Administrative Code 62-550 – Secondary Drinking Water Standards
 8. Additional Parameters (as defined below)
- D. The laboratory reports shall be submitted in Adobe PDF format along with a Microsoft Excel spreadsheet of all data.
- E. The following subsections summarize
- F. Microorganisms (perform sampling and testing following well disinfection)

Contaminant
Cryptosporidium
Giardia lamblia
Heterotrophic plate count (HPC)
Legionella
Total Coliforms (including fecal coliform and E. Coli)
Turbidity
Viruses (enteric)

G. Disinfection By-Products

CAS No.	Contaminant	MCL
15541-45-4	Bromate	0.010 mg/L
14998-27-7	Chlorite	1.0 mg/L
Not Applicable	TTHM	0.080 mg/L
Not Applicable	HAA5	0.060 mg/L

CAS Number = Chemical Abstract Service Number

H. Inorganic Contaminants

CAS No.	Contaminant	MCL (mg/L)
7440-36-0	Antimony	0.006
7440-38-2	Arsenic	0.010
1332-21-4	Asbestos	7 MFL
7440-39-3	Barium	2
7440-41-7	Beryllium	0.004
7440-43-9	Cadmium	0.005
57-12-5	Cyanide (as free Cyanide)	0.2
7782-41-4	Fluoride	4.0
7439-92-1	Lead	0.015
7439-97-6	Mercury	0.002
7440-02-0	Nickel	0.1
14797-55-8	Nitrate	10 (as N)
14797-65-0	Nitrite	1 (as N)
Not Applicable	Total Nitrate and Nitrite	10 (as N)
7782-49-2	Selenium	0.05
7440-23-5	Sodium	160

CAS No.	Contaminant	MCL (mg/L)
7440-28-0	Thallium	0.002

MCL = maximum contaminant level;
MFL = million fibers per liter (longer than 10 micrometers);
mg/L = milligrams per liter

I. Volatile Organic Contaminants

CAS Number	Contaminant	MCL (mg/L)
75-35-4	1,1-Dichloroethylene	0.007
71-55-6	1,1,1-Trichloroethane	0.2
79-00-5	1,1,2-Trichloroethane	0.005
107-06-2	1,2-Dichloroethane	0.003
78-87-5	1,2-Dichloropropane	0.005
120-82-1	1,2,4-Trichlorobenzene	0.07
71-43-2	Benzene	0.001
56-23-5	Carbon tetrachloride	0.003
156-59-2	cis-1,2-Dichloroethylene	0.07
75-09-2	Dichloromethane	0.005
100-41-4	Ethylbenzene	0.7
108-90-7	Monochlorobenzene	0.1
95-50-1	o-Dichlorobenzene	0.6
106-46-7	para-Dichlorobenzene	0.075
100-42-5	Styrene	0.1
127-18-4	Tetrachloroethylene	0.003
108-88-3	Toluene	1
156-60-5	trans-1,2-Dichloroethylene	0.1
79-01-6	Trichloroethylene	0.003
75-01-4	Vinyl chloride	0.001
1330-20-7	Xylenes (total)	10

CAS Number = Chemical Abstract Service Number
MCL = maximum contaminant level
mg/L = milligrams per liter

J. Synthetic Organic Contaminants

CAS Number	Contaminant	MCL (mg/L)	Regulatory Detection Limit (mg/L)
1746-01-6	2,3,7,8-TCDD (Dioxin)	3 X 10 ⁻⁸	5 x 10 ⁻⁹
94-75-7	2,4-D	0.07	0.0001
93-72-1	2,4,5-TP (Silvex)	0.05	0.0002
15972-60-8	Alachlor	0.002	0.0002
1912-24-9	Atrazine	0.003	0.0001
50-32-8	Benzo(a)pyrene	0.0002	0.00002
1563-66-2	Carbofuran	0.04	0.0009
57-74-9	Chlordane	0.002	0.0002
75-99-0	Dalapon	0.2	0.001
103-23-1	Di(2-ethylhexyl)adipate	0.4	0.0006
117-81-7	Di(2-ethylhexyl)phthalate	0.006	0.0006
96-12-8	Dibromochloropropane (DBCP)	0.0002	0.00002
88-85-7	Dinoseb	0.007	0.0002
85-00-7	Diquat	0.02	0.0004
145-73-3	Endothall	0.1	0.009
72-20-8	Endrin	0.002	0.00001
106-93-4	Ethylene dibromide (EDB)	0.00002	0.00001
1071-83-6	Glyphosate	0.7	0.006
76-44-8	Heptachlor	0.0004	0.00004
1024-57-3	Heptachlor epoxide	0.0002	0.00002
118-74-1	Hexachlorobenzene	0.001	0.0001
77-47-4	Hexachlorocyclopentadiene	0.05	0.0001
58-89-9	Lindane	0.0002	0.00002
72-43-5	Methoxychlor	0.04	0.0001
23135-22-0	Oxamyl (vydate)	0.2	0.002
87-86-5	Pentachlorophenol	0.001	0.00004
1918-02-1	Picloram	0.5	0.0001
1336-36-3	Polychlorinated biphenyls (PCBs)	0.0005	0.0001
122-34-9	Simazine	0.004	0.00007
8001-35-2	Toxaphene	0.003	0.001

CAS Number = Chemical Abstract Service Number

MCL = maximum contaminant level

mg/L = milligrams per liter

K. Radionuclides

CAS Number	Contaminant	MCL
13982-63-3 and 15262-20-1	Combined radium-226 and radium-228	5 pCi/L
12587-46-1	Gross alpha particle activity including radium-226 but excluding radon and uranium	15 pCi/L
7440-61-1	Uranium	30 ug/L

CAS Number = Chemical Abstract Service Number

MCL = maximum contaminant level

pCi/L = picoCuries per liter

ug/L = micrograms per liter

L. Secondary Drinking Water Standards

CAS Number	Contaminant	SMCL (mg/L)
7429-90-5	Aluminum	0.2
16887-00-6	Chloride	250
7440-50-8	Copper	1
16984-48-8	Fluoride	2.0
7439-89-6	Iron	0.3
7439-96-5	Total Manganese	0.05
7439-96-5	Dissolved Manganese	Not Applicable
7440-22-4	Silver	0.1
14996-02-2	Sulfate (SO ₄ ²⁻)	250
7440-66-6	Zinc	5
	Color	15 color units
	Odor	3 (threshold odor number)
12408-02-5	pH	6.5 - 8.5
CASID10052	Total Dissolved Solids	500
	Foaming Agents	0.5

CAS Number = Chemical Abstract Service Number

SMCL = maximum contaminant level

mg/L = milligrams per liter

M. Additional Parameters

CAS No.	Parameters
335-67-1	Perfluorooctanoic acid (PFOA)

CAS No.	Parameters
1763-23-1	Perfluorooctane sulfonate (PFOS)
Not Applicable	PFOA plus PFOS
Not Applicable	M-Alkalinity (total alkalinity)
71-52-3	P-Alkalinity
7440-70-2	Calcium ion (Ca^{2+})
7440-70-2	Calcium Hardness (as CaCO_3)
7439-95-4	Magnesium ion (Mg^{2+})
7439-95-4	Magnesium Hardness (as CaCO_3)
124-38-9	Dissolved Carbon Dioxide (CO_2)
3812-32-6	Carbonate ion (CO_3^{2-})
71-52-3	Bicarbonate ion (HCO_3^-)
7440-44-0	Dissolved Inorganic Carbon (DIC)
7440-44-0	Total Organic Carbon (TOC)
Not Applicable	Carbonate Hardness (as CaCO_3)
Not Applicable	Magnesium Hardness (as CaCO_3)
Not Applicable	Total Hardness (as CaCO_3)
18496-25-8	Dissolved Sulfide
18496-25-8	Total Sulfide
7664-41-7	Free Ammonia (NH_3 as N)
7664-41-7	Ammonium Ion (NH_4^+ as N)
7664-41-7	Total Ammonia
15438-31-0	Ferrous Ion Iron (Fe^{2+})
20074-52-6	Ferric Ion Iron (Fe^{3+})
7439-89-6	Total Iron
Not Applicable	Total Kjeldahl Nitrogen (TKN)
Not Applicable	Temperature
Not Applicable	Specific conductance
7782-44-7	Dissolved Oxygen

CAS Number = Chemical Abstract Service Number

3.08 FURTHER DEVELOPMENT

- A. The Contractor shall discontinue the test and resume well development if considerable quantities of fines are pumped out of the well during the test. The Engineer shall be the sole judge as to whether such additional development is necessary.

- B. The Contractor shall sound the well and remove any sand or silt accumulated in the well as a result of the pumping test after completion of the pumping test.

3.09 DISPOSAL OF WATER

- A. See requirements specified in Section 02851 titled "DRILLING".

- END OF SECTION -

SECTION 02859

WELL DEVELOPMENT

PART 1-- GENERAL

1.01 THE REQUIREMENT

- A. Provide all work, materials, and equipment necessary for the development of the water supply wells, complete.
- B. To the maximum extent practicable, perform all well development during daylight hours.
- C. The well shall be developed until wells specific capacity continues to increase and until the water averages less than 5-mg/L of sand at a discharge rate of 2,200-gpm during a one-hour test. It is anticipated a minimum of 120 hours of development will be required to achieve this standard. It is noted that the Engineer shall be the sole judge as to when development is complete and may therefore increase or decrease the total development time.
- D. The Contractor shall supply a Rossum Sand Tester. The Contractor shall record sand concentrations as indicated in Part 3.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION

3.01 MATERIALS AND EQUIPMENT

- A. Provide all necessary compressors, piping, tools, pumps, and any other equipment to develop the wells by airlifting and high rate pumping to obtain a maximum flow.

3.02 AIR DEVELOPMENT

- A. Initial development shall be by open reverse-air circulation. This shall be implemented by tripping the drill bit in the well and varying the intake depth throughout the entire open hole section while maintaining circulation. The Contractor shall continue development until it is determined by the Engineer that all visible particulate matter has been removed from a grab sample of the developed water. Prior to removing the drill string, the Contractor shall ensure that no cuttings or debris remain in the bottom of the borehole
- B. After reverse-air development has been completed the Contractor shall develop the well by air surging. Contractor shall provide an airline and compressor of adequate size and length to surge the well with air. Contractor shall also provide all necessary equipment to develop the wells as needed. Equipment shall include lateral outlets and necessary piping and valves to control and measure flow during development. Airlift equipment shall be capable of surging the well at rate up to 2,200 gpm.

- C. The Contractor shall clean the well if fines are drawn into the well excessively during air surging before continuing with air surging.

3.03 WATER SAMPLING DURING AIR DEVELOPMENT

- A. Prior to every drill pipe connection during all reverse-air drilling operations (maximum interval of 30 feet) the Contractor shall assist the Engineer in collecting a clear water sample from the drill stem discharge after cuttings have been flushed from the well.
- B. Water samples will be analyzed in the field by the Engineer for conductivity and temperature. The Contractor shall provide a calibrated instrument acceptable to the Engineer for conducting field measurements.
- C. The Contractor's laboratory shall perform the following tests: total dissolved solids (TDS), temperature, chlorides and conductivity.

3.04 DEVELOPMENT BY PUMPING

- A. The Contractor shall complete well development by high rate pumping and surging. For this purpose the Contractor shall furnish and install a pump capable of withdrawing at least 2,750 gpm from each production well. The wells shall be repeatedly surged during this process. A calibrated flow meter shall be installed on the discharge pipe to measure the pumping rate.
- B. During pump development the Contractor shall furnish a centrifugal sand sampler, or other approved method of quantifying sand content in the part per million range, a calibrated turbidity meter, and a silt density kit. The Contractor shall periodically sample the pump discharge for turbidity, sand content, and silt density index analysis to determine when adequate development has been achieved to the satisfaction of the Engineer. These results shall be recorded in the Contractor's daily log.
- C. The Contractor shall not remove pump or appurtenant equipment until the work is complete as specified by Engineer.
- D. The Contractor is solely responsible for all disposal of water during pumping tests and for obtaining all necessary permits.

3.05 SAND CONCENTRATION CALCULATION

- A. Follow the manufacturer's instructions for the Rossum Sand Tester.
- B. The Contractor check the flow rate through the Rossum Sand Tester during each test. If the flow rate is not 0.5-gpm, repeat the test.
- C. Record data in an Excel spreadsheet for each test. Submit the results to the Engineer. An example spreadsheet is provided on the following page. The Engineer will provide its spreadsheet to the Contractor upon request.

Sand Concentration Calculation

Well	Hallandale Production Well PW-9
Date	
Pump Flow	2,200 gpm

Test Period (minutes)		Tube Reading (mL)	Incremental Accumulation (mL)	Incremental Time (minute)	Flow Rate from Sand Tester (gpm)	Sand Content (ppm)
Start	Finish					
1.0	5.0	0.10	0.10	4.00	0.5	13.21
5.0	10.0	0.20	0.10	5.00	0.5	10.57
10.0	15.0	0.20	0.00	5.00	0.5	0.00
15.0	20.0	0.20	0.00	5.00	0.5	0.00
20.0	25.0	0.25	0.05	5.00	0.5	5.28
25.0	30.0	0.30	0.05	5.00	0.5	5.28
30.0	35.0	0.40	0.10	5.00	0.5	10.57
35.0	40.0	0.43	0.03	5.00	0.5	3.17
40.0	45.0	0.51	0.08	5.00	0.5	8.45
45.0	50.0	0.52	0.01	5.00	0.5	1.06
50.0	55.0	0.53	0.01	5.00	0.5	1.06
55.0	60.0	0.54	0.01	5.00	0.5	1.06

Average Sand Content

4.98 mg/L

Example

- END OF SECTION -

SECTION 02860

WELLHEAD DISINFECTION

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall provide all work, materials, and equipment necessary for disinfecting each well, complete.
- B. The Contractor shall be responsible for obtaining passage of bacterial tests as may be required by jurisdictional agencies.
- C. The Contractor shall be responsible for complying with all the requirements specified in Florida Administrative Code 62-555 entitled "*Permitting, Construction, Operation and Maintenance of Public Water Systems*" and AWWA Standard C654 entitled "*Disinfection of Wells*".
- D. Provide instrumentation to test free chlorine residual.
- E. Furnish and install temporary caps on the wellhead prior to installation of the permanent wellhead pumping equipment.

1.02 SUBMITTALS

- A. Testing Procedures: The Contractor shall submit to the Engineer for review detailed procedures for disinfection and testing to achieve bacteriological clearance. The procedures shall include the testing laboratory which will perform services.
- B. Test Results: Submit copies of all bacteriological testing results.

PART 2 -- PRODUCTS

2.01 MATERIALS

- A. The Contractor shall provide all chemicals and equipment necessary to perform disinfection complete. Said equipment may include pumps, hoses, fittings, etc.
- B. The Contractor shall be responsible for transport and handling of all chlorine and/or disinfectants in accordance with appropriate regulations and manufacturer's recommendations.

2.02 LABORATORY SERVICES

- A. The total residual chlorine measurements required by this specification, may be performed by any authorized representative of the supplier of water or person constructing or altering the well but shall be performed following the appropriate procedures in the Department of Environmental Protection Standard Operating Procedures for Field Activities, DEP-SOP-001/01 as incorporated into Rule 62-160.800, Florida Administrative Code (FAC).
- B. The total coliform or E. coli analyses required under this specification. shall be performed by a laboratory retained by the Contractor. The laboratory shall be certified by the Florida Department of Health to perform bacteriological analyses of drinking water and shall be performed using an appropriate method referenced in rule 62-550.550(1), FAC.

PART 3 -- EXECUTION

3.01 GENERAL

- A. The Contractor shall comply with AWWA C654 standards and FAC 62-555.
- B. The Contractor shall dispose of any waters produced while disinfecting wells in accordance with applicable regulations.

3.02 CHLORINATION OF PERMANENT EQUIPMENT USED IN WELLS

- A. All permanent equipment and materials to be installed in the well shall be chlorinated just prior to installation. This shall be done by spray the equipment with a solution have a chlorine residual of not less than 200 mg/L.

3.03 CHLORINATION OF WELL AFTER PERMANENT EQUIPMENT IS INSTALLED

- A. Standards: After the permanent pumping equipment is installed, the Contractor shall disinfect the wells in accordance with ANSI/AWWA A100, "Water Wells" and ANSI/AWWA C654, "Disinfection of Wells".
- B. General: The Contractor shall submit to the Engineer for review of is procedure for disinfection prior to its implementation. The Contractor shall notify the Engineer in writing at least 24 hours in advance of the implementation of the accepted disinfection procedures. The Contractor shall re-disinfect well at his own expense should the well fail to pass bacteriological clearance. The disinfected well will be tested for the presence of coliform by the Contractor's laboratory. If bacterial evaluation fails, disinfection shall be repeated until the bacteriological test results indicate a pass.
- C. Add Chlorine to the Well: The Contractor shall apply a chlorine solution of such volume to achieve a free chlorine residual of at least 100-ppm. Follow the procedure described in AWWA C654.

- D. Surge the Well: After the chlorine has been applied, the well shall be surged at least three times to improve the mixing and induce contact of the chlorinated water with the adjacent aquifer.
- E. Pre-Rest Period Residual Verification: The chlorine residual shall be verified after surging. If the free-chlorine residual drops below 50-ppm then add more chlorine, surge the well and retest the residual.
- F. Rest Period: The chlorinated water shall be allowed to rest in the casing for at least 12-hours but no more than 24-hours.
- G. Pump to Waste: After the well has been chlorinated and allowed to rest for at least 12-hours, it shall be pumped to waste. The discharge water shall be tested periodically for chlorine residual. When no detected chlorine residual is measured, the well shall continue to be pumped to waste for at 15 minutes before proceeding with bacteriological sampling.

3.04 BACTERIOLOGICAL CLEARANCE

- A. The Contractor shall retain a laboratory certified by the Florida Department of Health to perform bacteriological analyses of drinking water.
- B. Bacteriological analyses shall be performed using methods referenced in rule 62-555.315(6), Florida Administrative Code (FAC).
- C. 20-Day Sampling: A total of at least 20 samples – each taken on a separate but consecutive workday and taken at least six hours apart from the other samples – shall be collected after first pumping the well to waste to remove all residual chlorine and then pumping the well to waste at a rate approximately equal to that of the permanent well pump for at least 15 minutes before each sample is collected, and the samples shall be analyzed for the presence of total residual chlorine, total coliform, and E. coli.
- D. The Florida Department of Environmental Protection (FDEP) may allow the required number of samples or the sample collection interval to be modified. It is the responsibility of the Contractor to obtain the written permission of the FDEP for alteration to this specification.
- E. If the FDEP allows collection of two samples per day, the samples shall be collected at least six hours apart, and the well shall be pumped to waste for at least 15 minutes before each sample is collected.
- F. If any sample shows the presence of free or combined chlorine, the sample shall be considered invalid.
- G. If any sample shows the presence of E. coli, the well shall be considered microbially contaminated. If E. coli is detected, disinfect the well and restart sampling.

- H. If more than ten percent of the total number of samples collected show the presence of total coliform or if either of the last two samples collected shows the presence of total coliform, the well shall be re-disinfected and resampled as required by the FAC.
- I. No disinfected well shall convey water to the Water Treatment Plant until bacteriological clearance reports have been accepted by the FDEP and the Engineer has received the written permission of the FDEP to place the well into service.

- END OF SECTION -

SECTION 03305 - CONCRETE AND GROUT

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Where shown on the Drawings or required for a complete project, furnish and install concrete and grout as described herein.
- B. The Contractor shall furnish all materials for concrete in accordance with the provisions of this Section and shall form, mix, place, cure, repair, finish, and do all other work as required to produce finished concrete, all in accordance with the requirements of the Contract Documents.
- C. The following types of concrete shall be covered in this Section:
 - 1. Structural Concrete: Concrete to be used in all cases except where noted otherwise in the Contract Documents.
 - 2. Sitework Concrete: Concrete to be used curbs, gutters, catch basins, sidewalks, cart paths, fence and guard post embedment, underground duct bank encasement and all other concrete appurtenant to electrical facilities unless otherwise shown or noted on the Drawings.
- D. The following types of grout are covered in this Section:
 - 1. Cement Grout: This type of grout shall be used wherever grout or cementitious grout is called for in the Contract Documents, unless another type is specifically referenced.
 - 2. Non-Shrink Grout: Non-shrink cementitious grout or non-shrink epoxy grout shall be used whenever non-shrink grout is called for. Non-shrink cementitious grout shall be used at locations where there are no dynamic loads, the grout will not come in contact with wastewater or wastewater gases. Non-shrink epoxy grout shall be used in submerged (water or wastewater), under wastewater gas environment, and for anchorage of pump bases, motor bases, and any other equipment imparting dynamic loads to the support system.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Division 16 – Electrical

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Codes: Without limiting the generality of other requirements of these specifications, all work specified herein shall conform to or exceed the requirements of the Florida Building Code and the applicable requirements of the following documents to the extent that the provisions of such documents are not in conflict with the requirements of this Section.

B. Commercial Standards:

ACI 214	Recommended Practice for Evaluation of Strength Test Results of Concrete
ACI 301	Specifications for Structural Concrete for Buildings.
ACI 305 ACI 306	Hot Weather Concreting Cold Weather Concreting
ACI 315	Manual of Standard Practice for Detailing Reinforced Concrete Structures.
ACI 318	Building Code Requirements of Reinforced Concrete.
ACI 347	Recommended Practice for Concrete Formwork.
ASTM A 185	Specification for Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement.
ASTM A 615	Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
ASTM C 31	Test Methods for Making and Curing Concrete Test Specimens in the Field.
ASTM C 33	Specification for Concrete Aggregates.
ASTM C 39	Test Method for Compressive Strength of Cylindrical Concrete Specimens.
ASTM C 88	Test Method for Soundness of Aggregates by use of Sodium Sulfate or Magnesium Sulfate
ASTM C 94	Specification for Ready-Mixed Concrete.
ASTM C 114	Method for Chemical Analysis of Hydraulic Cement
ASTM C 136	Method for Sieve Analysis of Fine and Coarse Aggregate
ASTM C 143	Test Method for Slump of Portland Cement Concrete.
ASTM C 150	Specification for Portland Cement.
ASTM C156	Test Method for Water Retention by concrete Curing Materials

ASTM C 157	Test Method for length Change of Hardened Cement Mortar and Concrete
ASTM C 192	Method of Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 227	Standard Test Method for Potential Alkali Reactivity of Cement Aggregate Combinations (Mortar-Bar Method).
ASTM C 260	Specification for Air-Entraining Admixtures for Concrete.
ASTM C 289	Standard Test Method for Potential Reactivity of Aggregates (Chemical Method)
ASTM C 309	Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
ASTM C 494	Specification for Chemical Admixtures for Concrete.
ASTM C 579	Test Methods for Compressive Strength of Chemical - Resistant Mortars and Monolithic Surfacing.
ASTM C 618	Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Portland Cement Concrete
ASTM C 827	Test Method for Early Volume Change of Cementitious Mixtures.
ASTM D 1751	Specification for Preformed Expansion Joint Fillers for Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
CRD C 621	Non-Shrink Grout
CRSI	Manual of Standard Practice.

C. Any procedure, materials or operation specified by reference to the American Society for Testing and Materials (ASTM), the American Concrete Institute (ACI), Building Code or other references shall comply with the requirements of the current and most recent specifications or standards. In conflicts between listed standards and this specification, the more stringent requirements shall govern.

D. The Contractor is expected to obtain the most recent issue of all standards, recommendations, codes or specifications referred to within this specification.

1.04 SUBMITTALS

- A. Mix Designs: The design mixes to be used shall be prepared by qualified persons and submitted for review. The design of the mix is the responsibility of the Contractor subject to the limitations of the specifications. Review processing of this submission will be required only as evidence the mix has been designed by qualified persons and that the minimum requirements of the specifications have been met. Such review will in no way alter the responsibility of the Contractor to furnish concrete meeting the requirements of the specifications. If in the progress of the work the sources of materials change in characteristics or the Contractor requests a new source in writing, the Contractor shall, at his expense submit new test data and information for the establishment of a new design mix. Submit mix designs for all classes of concrete to be used under this Contract. Mix design submittals shall include the following:
1. Sources of all materials and certifications of compliance with specifications for all sources of each material.
 2. Certified current (less than one year old) chemical analysis of Portland Cement or Blended Cement to be used.
 3. Certified current (less than one year old) chemical analysis of fly ash to be used.
 4. Aggregate test results showing compliance with required standards, i.e. sieve analysis, aggregate soundness tests, etc.
 5. Manufacturer's data on all admixtures stating compliance with required standards and are compatible with one another. Written conformance to the above mentioned requirements and the chloride ion content of the admixture will be required from the admixture manufacturer prior to Mix design review by the Engineer.
 6. Field experience records and/or trial mix data for the proposed concrete mixes.
- C. Grout: The Contractor shall submit shop drawings for all types of grout for use in this Project. Shop drawings shall include certified test results verifying the compressive strength, shrinkage, and expansion requirements specified herein; and manufacturer's literature containing instructions and recommendations on the mixing, handling, placement and appropriate uses for each type of grout used in the work.
- D. Accessories: The Contractor shall submit shop drawings for all types of concrete accessories to be used for this project including, but not limited to, form ties, water stops, joint materials and curing agents.
- E. Delivery Tickets: Where ready-mix concrete is used, the Contractor shall submit delivery tickets at the time of delivery of each load of concrete. Each certificate shall show the State certified equipment used for measuring and the total quantities, by weight, of cement, sand, each class of aggregate, admixtures, and the amounts of water in the aggregate and added at the batching plant as well as the amount of water allowed to be added at the site for the specific design mix. Each certificate shall, in addition, state the mix number, total yield in cubic yards, and the time of day, to the nearest minute,

corresponding to when the batch was dispatched, when it left the plant, when it arrived at the job, the time that unloading began, and the time that unloading was finished.

- F. Reinforcing Steel: The Contractor shall submit shop drawings of shop bending diagrams, placing lists, and Drawings of all reinforcing steel prior to fabrication.
1. The Contractor shall submit detailed placing and shop fabricating drawings, prepared in accordance with ACI 315 and ACI Detailing Manual - (SP66) for all reinforcing steel. These drawings shall be made to such a scale as to clearly show joint locations, openings, the arrangement, spacing and splicing of the bars. Where opening sizes are dependent on equipment selection the Contractor shall indicate all necessary dimensions to define steel lengths and placing details.
 2. Details of the concrete reinforcing steel and concrete inserts shall be submitted by the Contractor at the earliest possible date after receipt by the Contractor of the Notice to Proceed. Said details of reinforcing steel for fabrication and erection shall conform to ACI 315 and the requirements specified and shown. The shop bending diagrams shall show the actual lengths of bars, to the nearest inch measured to the intersection of the extensions (tangents for bars of circular cross section) of the outside surface. The shop Drawings shall include bar placement diagrams which clearly indicate the dimensions of each bar splice.
 3. Where mechanical couplers are shown on the Drawings to be used to splice reinforcing steel, the Contractor shall submit manufacturer's literature which contains instructions and recommendations for installation for each type of coupler used; certified test reports which verify the load capacity of each type and size of coupler used; and shop Drawings which show the location of each coupler with details of how they are to be installed in the formwork.
 4. If reinforcing steel is spliced by welding at any location, the Contractor shall submit mill test reports which shall contain the information necessary for the determination of the carbon equivalent as specified in AWS D1.4. The Contractor shall submit a written welding procedure for each type of weld for each size of bar which is to be spliced by welding, merely a statement that AWS procedures will be followed is not acceptable. Welding of rebar shall be done only where shown on the Drawings or allowed in writing by the Engineer.
- G. Curing: Submit the following in accordance with Supplementary General Provisions Section 2.2b.
1. Proposed procedures for protection of concrete under wet weather placement conditions.
 2. Proposed normal procedures for protection and curing of concrete.
 3. Proposed special procedures for protection and curing of concrete under hot and cold weather conditions.
 4. Proposed method of measuring concrete surface temperature changes.

5. Manufacturer's literature and material certification for proposed curing compounds.

1.05 QUALITY ASSURANCE

- A. Tests on component materials and for compressive strength of concrete will be performed as specified herein. Test for determining slump will be in accordance with the requirements of ASTM C 143.
- B. The cost of initial trial mixes and initial laboratory tests to design the mixes including compression tests, sieve analysis, and tests on trial mixes shall be included in the Contract Price.
- C. The cost of all laboratory tests on cement, aggregates, and concrete, will be borne by the Owner. However, the Contractor shall be charged for the cost of any additional tests and investigation on work performed which does not meet the specifications.
- C. Concrete for testing shall be supplied by the Contractor at no cost to the Owner, and the Contractor shall provide assistance to the Engineer in obtaining samples. The Contractor shall dispose of and clean up all excess material.
- F. Construction Tolerances: The Contractor shall set and maintain concrete forms and perform finishing operations so as to ensure that the completed work is within the tolerances specified herein. Surface defects and irregularities are defined as finishes and are to be distinguished from tolerances. Tolerance is the specified permissible variation from lines, grades, or dimensions shown. Where tolerances are not stated in the Specifications, permissible deviations will be in accordance with ACI 347.

1.06 QUALITY CONTROL

- A. Compressive Strength
 1. Compression test specimens shall be taken during construction from the first placement of each class of concrete specified herein and at intervals thereafter as selected by the Engineer to insure continued compliance with these Specifications. At least one set of test specimens shall be made for each placement in excess of five cubic yards, or for each fifty (50) cubic yards of concrete placed, or for each 5000 square feet of surface area for slabs or walls, whichever is greater.
 2. Samples of freshly mixed concrete shall be obtained in accordance with ASTM C 172, and compression test specimens for concrete shall be made in accordance with ASTM C 31. Specimens shall consist of at least five 6-inch diameter by 12-inch high cylinders, or eight 4-inch diameter by 8-inch high cylinders. Each cylinder shall be identified by a tag attached to the side of the cylinder.
 3. The Contractor shall provide approved curing boxes for storage of cylinders on site. The insulated curing box shall be of sufficient size and strength to contain all the specimens made in any four consecutive working days and to protect the specimens from falling over, being jarred or otherwise disturbed during the period

of initial curing. The box shall be erected, furnished and maintained by the Contractor. Such box shall be equipped to provide the moisture and to regulate the temperature necessary to maintain the proper curing conditions required by ASTM C31. Such box shall be located in an area free from vibration such as pile driving and traffic of all kinds. No concrete requiring inspection shall be delivered to the site until such storage curing box has been provided. Specimens shall remain undisturbed in the curing box until ready for delivery to the testing laboratory but not less than sixteen hours

4. Compression test shall be performed in accordance with ASTM C 39. For 6x12 cylinders, two test cylinders will be tested at 7 days and 2 at 28 days. For 4x8 cylinders, three test cylinders will be tested at 7 days and three at 28 days. The remaining cylinders will be held to verify test results, if needed.

B. Consistency

1. Consistency of the concrete will be checked by the Engineer by standard slump cone tests. The Contractor shall make any necessary adjustments in the mix as the Engineer may direct and shall upon written order suspend all placing operations in the event the consistency does not meet the intent of the specifications. No payment shall be made for delays, material or labor costs due to such eventualities.
2. Slump tests shall be made in accordance with ASTM C 143. Slump tests shall be performed as deemed necessary by the Engineer and each time compressive strength samples are taken.

C. Air Content

1. Samples of freshly mixed concrete will be tested for entrained air content by the Engineer in accordance with ASTM C 231.
2. Air content tests will be performed as deemed necessary by the Engineer and each time compressive strength samples are taken.

D. Evaluation and Acceptance of Concrete

1. Evaluation and acceptance of the compressive strength of concrete shall be according to the requirements of ACI 215 and ACI 318, Chapter 5 "Concrete Quality Mixing and Placing", and as specified herein.
2. If any concrete fails to meet these requirements, immediate corrective action shall be taken to increase the compressive strength for all subsequent batches of the type of concrete affected.
3. All concrete which fails to meet the ACI requirements and these specifications, is subject to removal and replacement at the cost of the Contractor. Additional testing may also be required to verify compressive strength of concrete. Additional testing shall involve extraction and testing of concrete cores in accordance with ASTM C 42. Engineer shall determine locations where concrete cores shall be

taken. Nondestructive test methods shall not be used to verify strength of in-place concrete.

1.07 DEFINITIONS

- A. In these Specifications, the term "Precast Concrete" shall mean precast manholes, handholes, vaults, pull boxes, and similar structures. It does not include precast prestressed concrete elements.

PART 2 -- PRODUCTS

2.01 FORMWORK

- A. Form Materials: Except as otherwise expressly accepted by the Engineer, all lumber for use as forms, shoring, or bracing shall be new material. Materials for concrete forms shall conform to the following requirements:

1. Form materials shall be metal, wood, plywood, or other acceptable material that will not adversely affect the concrete and will facilitate placement of concrete to the shape, form, line, and grade shown.
2. Plywood for concrete formwork shall be new, waterproof, synthetic resin bonded, exterior type Douglas Fir or Southern Pine plywood manufactured especially for concrete formwork and shall conform to the requirements of PS 1 for Concrete Forms, Class 1, and shall be edge sealed. Wood forms for surfaces to be painted shall be Medium Density Overlaid plywood, MDO Exterior Grade. Thickness shall be as required to support concrete at the rate it is placed, but not less than 5/8-inch thick.

- B. Formwork Accessories:

1. Unless otherwise shown, exterior corners in concrete members shall be provided with 3/4-inch chamfers. Re-entrant corners in concrete members shall not have fillets unless otherwise shown.
2. Form ties shall be provided with a plastic cone or other suitable means for forming a conical hole to insure that the form tie may be broken off back of the face of the concrete. The maximum diameter of removable cones for rod ties, or of other removable form-tie fasteners having a circular cross-section, shall not exceed 1-1/2 inches; and all such fasteners shall be such as to leave holes of regular shape for reaming.
3. Form ties for water-retaining structures shall have integral waterstops. Removable taper ties may be used when acceptable to the Engineer. At locations where acceptable, a preformed neoprene or polyurethane tapered plug sized to seat at the center of the wall shall be inserted in the hole left by the removal of the taper tie.

4. Form release agent shall be a blend of natural and synthetic chemicals that employs a chemical reaction to provide quick, easy and clean release of concrete from forms. It shall not stain the concrete and shall leave the concrete with a paintable surface. Formulation of the form release agent shall be such that it would minimize formation of "Bug Holes" in cast-in-place concrete.

2.02 CONCRETE MATERIALS

- A. Materials shall be delivered, stored, and handled so as to prevent damage by water or breakage. Only one brand of cement shall be used. Cement reclaimed from cleaning bags or leaking containers shall not be used. All cement shall be used in the sequence of receipt of shipments.
- B. All materials furnished for the work shall comply with the requirements of ACI 301, as applicable.
- C. Storage of materials shall conform to the requirements of ACI 301.
- D. Materials for concrete shall conform to the following requirements:
 1. Cement shall be standard brand Portland cement conforming to ASTM C 150 Type II. A single brand of cement shall be used throughout the work, and prior to its use, the brand shall be acceptable to the Engineer. The cement shall be suitably protected from exposure to moisture until used. Cement that has become lumpy shall not be used. Sacked cement shall be stored in such a manner as to as to permit access for inspection and sampling. Certified mill test reports for each shipment of cement to be used shall be submitted to the Engineer, verifying compliance with these Specifications.
 2. Water shall be potable, clean, and free from objectionable quantities of silty organic matter, alkali, salts and other impurities. The water shall be considered potable, for the purposes of this Section only, if it meets the requirements of the local governmental agencies. Agricultural water with high total dissolved solids (over 1000 mg/1 TDS) shall not be used.
 3. Aggregates shall be obtained from pits acceptable to the Engineer, shall be non-reactive, and shall conform to the Florida Building Code and ASTM C 33. Maximum size of coarse aggregate shall be as specified in Paragraph titled "CONCRETE DESIGN REQUIREMENTS".
 4. Ready-mix concrete shall conform to the requirements of ASTM C 94.
 5. Air-entraining agent meeting the requirements of ASTM C 260, shall be used. Sufficient air-entraining agent shall be used to provide a total air content of 3 to 5 percent. The Owner reserves the right, at any time, to sample and test the air- entraining agent received on the job by the Contractor. The air-entraining agent shall be added to the batch in a portion of the mixing water. The solution shall be batched by means of a mechanical batcher capable of accurate measurement.

6. Water reducing and retarding admixtures shall be required at the Engineer's discretion or, if not required, may be added at the Contractor's option to control the set, effect water reduction, and increase workability. In either case, the addition of an admixture shall be at no additional cost to the Owner. The use of an admixture shall be subject to acceptance by the Engineer. Admixtures permitted shall conform to the requirements of ASTM C 494 (chemical admixtures). Admixtures shall contain no free chloride ions, be non-toxic after 30 days and shall be compatible with and made by the same manufacturer as the air entraining admixture.

2.03 CURING MATERIALS

- A. Materials for curing concrete conform to ASTM C 309 Type 1-D, Class B with a minimum solids content of 30% and shall contain a fugitive dye. Curing compound shall be SureCure 30 by Kaufman Products, Inc., CA D.O.T. Acrylic Cure by Symons Corporation, Sealtight CS-309-30 by W. R. Meadows, or approved equal.
- B. Polyethylene sheet for use as a concrete curing blanket shall be white and have a nominal thickness of 6 mils.

2.04 JOINT MATERIALS

- A. Materials for joints in concrete shall conform to the following requirements:
 1. Preformed joint filler shall be a non-extruding, resilient, bituminous type conforming to the requirements of ASTM D 1751.
 2. Elastomeric joint sealer shall be a single component, pour grade, polyurethane sealant meeting FS TT-S-230A, Type 1. Material shall attain Shore A Hardness of 40-45.
 3. Mastic joint sealer shall be a material that does not contain evaporating solvents; that will tenaciously adhere to concrete surfaces; that will remain permanently resilient and pliable; that will not be affected by continuous presence of water and will not in any way contaminate potable water; and that will effectively seal the joints against moisture infiltration even when the joints are subject to movement due to expansion and contraction. The sealer shall be composed of special asphalts or similar materials blended with lubricating and plasticizing agents to form a tough, durable mastic substance containing no volatile oils or lubricants and shall be capable of meeting the test requirements set forth hereinafter, if testing is required by the Engineer.
- B. Joint Cleaner: Joint cleaner shall be as recommended by the sealant caulking compound manufacturer.
- C. Joint Primer: Joint primer shall be as recommended by sealant manufacturer.

2.05 REINFORCING STEEL

- A. General: All reinforcing steel for all reinforced concrete construction shall conform to the following requirements:
1. Bar reinforcement shall conform to the requirements of ASTM A 615 for Grade 60 Billet Steel Reinforcement with supplementary requirement S-1, and shall be manufactured in the United States.
 2. Welded wire fabric reinforcement shall conform to the requirements of ASTM A185. All welded wire fabric reinforcement shall be galvanized.
- B. Accessories: Accessories shall include all necessary bolsters, chairs, spacers and other devices for supporting and fastening reinforcing in place complying with CRSI recommendations conforming to Class 1 bar supports. Bolsters for slab on grade shall have gray plastic tipped legs.
- C. Concrete blocks (dobies), used to support and position reinforcement steel, shall have the same or higher comprehensive strength as specified for the concrete in which it is located. Where the concrete blocks are used on concrete surfaces exposed to view, the color and texture of the concrete blocks shall match that required for the finished surface. Wire ties shall be embedded in concrete block bar supports.
- D. Couplers used to mechanically splice reinforcing steel shall develop a tensile strength which exceeds 125 percent of the yield strength of the reinforcing bar being spliced. Hot forged sleeve type couplers shall not be used. Acceptable mechanical couplers are: Dayton Superior Dowel Bar Splicer System by Dayton Superior.

2.06 DOWEL ADHESIVE SYSTEM

- A. Where shown on the Contract Drawings, reinforcing bars anchored into hardened concrete with a dowel adhesive system shall use a two-component adhesive mix which shall be injected with a static mixing nozzle following manufacturer's recommendations. All holes shall be drilled with a carbide bit unless otherwise recommended by the manufacturer. If coring holes is allowed by the manufacturer and approved by the Engineer, cored holes shall be roughened in accordance with manufacturer requirements. Thoroughly clean drill holes of all debris and drill dust with compressed air followed by a wire brush prior to installation of adhesive and reinforcing bar. Degree of hole dampness shall be in strict accordance with manufacturer recommendations. Where depth of hole exceeds the length of the static mixing nozzle, a plastic extension hose shall be used to ensure proper adhesive injection from the back of the hole. Injection of adhesive into the hole shall utilize a piston plug to minimize the formation of air pockets. The embedment depth of the bar shall be per manufacturer's recommendations, so as to provide a minimum allowable bond strength that is equal to 125 percent of the yield strength of the bar, unless noted otherwise on the Drawings. The adhesive system shall comply with the latest revision of ICC-ES Acceptance Criteria AC308, and shall have a valid ICC-ES report in accordance with the applicable building code. The adhesive system shall be "HIT-HY 150 MAX-SD Injection Adhesive Anchoring System" as manufactured by Hilti, Inc. "PE-1000 SD" by Powers Fasteners, "SET-XP" by Simpson Strong-Tie Co. or "Epcon System

G5" as manufactured by ITW Redhead. Engineer's approval is required for use of this system in locations other than those shown on the Contract Drawings.

- B. All individuals installing dowel adhesive system shall be certified as an Adhesive Anchor Installer in accordance with the ACI-CRSI Anchor Installation Certification Program.

2.07 READY-MIXED CONCRETE

- A. Ready-mixed concrete shall conform to meeting the requirements as to materials, batching, mixing, transporting, and placing as specified herein and in accordance with ASTM C 94.
- B. Ready-mixed concrete shall be delivered to the site of the work, and discharge shall be completed within one and one half hour after the addition of the cement to the aggregates or before the drum has been revolved 250 revolutions, whichever is first. In hot weather, or under conditions contributing to quick stiffening of the concrete, or when the temperature of the concrete is 85 degrees F or above, the time between the introduction of the cement to the aggregates and discharge shall not exceed 60 minutes.

2.08 CEMENT GROUT

- A. Cement grout shall be composed of Portland cement and sand in the proportion specified in the Contract Documents and the minimum amount of water necessary to obtain the desired consistency. If no proportion is indicated, cement grout shall consist of one part Portland cement to three parts sand. Water amount shall be as required to achieve desired consistency without compromising strength requirements. White Portland cement shall be mixed with Portland cement as required to match color of adjacent concrete.
- B. The minimum compressive strength at 28 days shall be 4000 psi.
- C. For beds thicker than 1-1/2 inch and/or where free passage of grout will not be obstructed by coarse aggregate, 1-1/2 parts of coarse aggregate having a top size of 3/8 inch should be added. This stipulation does not apply for grout being swept in by a mechanism. These applications shall use a plain cement grout without coarse aggregate regardless of bed thickness.
- D. Sand shall conform to the requirements of ASTM C144.

2.09 NON-SHRINK GROUT

- A. Non-shrink Cement Grout:
 - 1. Non-shrink cement grout shall be a prepackaged, inorganic, non-gas liberating, nonmetallic, cement-based grout requiring only the addition of water. Manufacturer's instructions shall be printed on each bag or other container in which the materials are packaged. The specific formulation for each class of nonshrink grout specified herein shall be that recommended by the manufacturer for the particular application.

2. Non-shrink cement grouts shall have a minimum 28 day compressive strength of 5000 psi (ASTM C109, restrained), shall have no shrinkage (0.0 percent) and a maximum 4.0 percent expansion in the plastic state when tested in accordance with ASTM C 827, and shall have no shrinkage (0.0 percent) and a maximum of 0.2 percent expansion in the hardened state when tested in accordance with CRD C 621.
3. Cement based grout shall be Five Star Grout as manufactured by Five Star Products, Inc., Fairfield, Connecticut, or approved equal.
4. Cementitious non-shrink grout shall be used at locations where there are no dynamic loads, the grout will not come in contact with wastewater or wastewater gases, and where non-shrink grout is identified on the Drawings. Applications include, but are not limited to, structural steel column base plates, gate frames and guides, and precast concrete to cast-in-place concrete joints.

B. Non-shrink Epoxy Grout:

1. Epoxy-based non-shrink grout shall be a three component, 100 percent solids, solvent-free system designed for machinery grouting. Applications include, but are not limited to, anchoring, pump and motor bases, and any other equipment imparting dynamic loads to the support system.
2. When non-shrink grout is identified on the Drawings in submerged (water or wastewater) or under wastewater gas environment, epoxy-based non-shrink grouts shall be used.
3. The epoxy grout shall be delivered to site as prepackaged, three-component systems composing of the resin, hardener, and specially blended aggregates. The components shall be stored as recommended by the manufacturer until use.
4. Non-shrink epoxy grout shall be Five Star DP Epoxy Grout by Five Star Products, Inc., Fairfield, Connecticut, or approved equal.

2.10 BONDING COMPOUND

- A. For bonding freshly-mixed, plastic concrete to hardened concrete, Sikadur 32 Hi-Mod Epoxy Adhesive, as manufactured by Sika Corporation; Concrecive Liquid (LPL), as manufactured by Master Builders; BurkEpoxy MV as manufactured by The Burk Company; or approved equal shall be used.

2.11 CONCRETE DESIGN REQUIREMENTS

- A. General: Concrete shall be composed of cement, admixtures, aggregates, and water. These materials shall be of the qualities specified. The exact proportions in which these materials are to be used for different parts of the work will be determined during the trial batch. In general, the mix shall be designed to produce a concrete capable of being deposited so as to obtain maximum density and minimum shrinkage and, where deposited in forms, to have good consolidation properties and maximum smoothness of surface. Mix

designs with more than 41 percent of sand of the total weight of fine and coarse aggregate shall not be used. The aggregate gradations shall be formulated to provide fresh concrete that will not promote rock pockets around reinforcing steel or embedded items. The proportions shall be changed whenever necessary or desirable to meet the required results at no additional cost to the Owner. All changes shall be subject to review by the Engineer.

- B. Water-Cement Ratio and Compressive Strength: The minimum compressive strength and cement content of concrete shall be not less than that specified in the following tabulation.

Type of Work	Min. 28-Day Compressive Strength (psi)	Max. Size Aggregate (in.)	Min. Cement per cu yd (sacks)	Max. W/C Ratio (by wt.)
<u>Structural Concrete</u> : All reinforced concrete unless noted otherwise below.	4,000 (Class A)	3/4	6.0	0.45
<u>Sitework Concrete</u> : Sidewalks and curb.	3,000 (Class B)	3/4	5.0	0.50

Note: One sack of cement equals 94 lbs.

- C. Adjustments to Mix Design: The mixes used shall be changed whenever such change is necessary or desirable to secure the required strength, density, workability, and surface finish, and the Contractor shall be entitled to no additional compensation because of such changes.

2.12 CONSISTENCY

- A. The consistency of the concrete in successive batches shall be determined by slump tests in accordance with ASTM C 143.

2.13 CHEMICAL RESISTANT WATERSTOP

- A. General: Waterstop shall be manufactured from thermoplastic elastomeric rubber material. The synthetic rubber shall provide a high resistance to acids, bases, alcohols, oils, solvents or chemicals. No reclaimed material shall be used. The Contractor shall obtain from the waterstop manufacturer and furnish to the Engineer for review, current test reports and a written certification of the manufacturer that the material to be shipped to the job meets the physical requirements outlined herein. Waterstop connections shall be heat welded. All waterstop corners, intersections, and directional changes shall be miter cut, heat welded, factory fabricated. Only straight butt splices shall be allowed in the field.
- B. Multi-Rib Waterstop: All chemical resistant waterstop shall be of multi-rib construction. Waterstop for expansion joints shall be 9-in x 3/16-in ribbed with a center bulb. Waterstop for construction joints shall be 6-in x 3/16-in ribbed with a center bulb. Chemical resistant waterstop shall be Westech Type TPE-R synthetic rubber, manufactured by Westech Barrier Technologies, St. Louis, MO, or equal.

- C. Waterstop Physical Properties: When tested in accordance with the specified test standards, the waterstop material shall meet or exceed the following requirements:

<u>Physical Property</u>	<u>Value</u>	<u>ASTM Std</u>
Tensile Strength	1800 psi	D-412
Ultimate Elongation	450%	D-412
100% Modulus	1000 psi	D-412
Shore "A" Hardness	85 units \pm 5 units	D-2240
Brittle Point	-70°F	D-746
Ozone Resistance	450 pphm passed	D-1171

- D. Weathering Performance: When tested in accordance with the specified test standards, the waterstop material shall meet or exceed the following requirements:

<u>Physical Property</u>	<u>Value</u>	<u>ASTM Std</u>
Tensile Strength (% Retention)	87%	D-412
Ultimate Elongation (% Retention)	84%	D-412
Shore "A" Hardness (units change)	7 units	D-2240

- E. Chemical Resistance Properties: When tested in accordance with ASTM D-471 after 166 hours of full immersion at 73.4°F (23°C), the waterstop material shall meet or exceed the following requirements:

<u>Fluid</u>	<u>Physical Property</u>	<u>Value</u>
Sodium Hypochlorite 17%	Ultimate Elongation	101 Retention
	Ultimate Tensile	107% Retention
	100% Modulus	104% Retention
	Hardness Change Shore A	-4 Unit
	Weight Change	-0.1%

2.14 PREFABRICATED FORMS

- A. Form materials shall be metal, wood, plywood, or other acceptable material that will not adversely affect the concrete and will facilitate placement of concrete to the shape, form, line, and grade indicated. Metal forms shall be an acceptable type that will accomplish such results. Wood forms for surfaces to be painted shall be Medium Density Overlaid plywood, MDO Ext. Grade.

2.15 FORMWORK ACCESSORIES

- A. Unless otherwise shown, exterior corners in concrete members shall be provided with 3/4-inch chamfers. Re-entrant corners in concrete members shall not have fillets unless otherwise shown.
- B. Form ties shall be provided with a plastic cone or other suitable means for forming a conical hole to insure that the form tie may be broken off back of the face of the concrete.

The maximum diameter of removable cones for rod ties, or of other removable form-tie fasteners having a circular cross-section, shall not exceed 1-1/2 inches; and all such fasteners shall be such as to leave holes of regular shape for reaming.

- C. Form release agent shall be a blend of natural and synthetic chemicals that employs a chemical reaction to provide quick, easy and clean release of concrete from forms. It shall not stain the concrete and shall leave the concrete with a paintable surface. Formulation of the form release agent shall be such that it would minimize formation of "Bug Holes" in cast-in-place concrete.

PART 3 -- EXECUTION

3.01 GENERAL FORMWORK REQUIREMENTS

- A. Forms to confine the concrete and shape it to the required lines shall be used wherever necessary. The Contractor shall assume full responsibility for the adequate design of all forms, and any forms which are unsafe or inadequate in any respect shall promptly be removed and replaced at the Contractor's expense. All design, construction, maintenance, preparation, and removal of forms shall be in accordance with the FBC, ACI 347 and the requirements specified herein.
- B. All forms shall be true in every respect to the required shape and size, shall conform to the established alignment and grade, and shall be of sufficient strength and rigidity to maintain their position and shape under the loads and operations incident to placing and vibrating the concrete.

3.02 FORMWORK CONSTRUCTION

- A. Vertical Surfaces: All vertical surfaces of concrete members shall be formed, except where placement of the concrete against the ground is called for by the Engineer.
- B. Construction Joints: Concrete construction joints will not be permitted at locations other than those shown or specified, except as may be acceptable to the Engineer. When a second lift is placed on hardened concrete, special precautions shall be taken in the way of the number, location, and tightening of ties at the top of the old lift and bottom of the new to prevent any unsatisfactory effect whatsoever on the concrete.
- C. Form Ties: Wire ties for holding forms will not be permitted. No form-tying device or part thereof, other than metal, shall be left embedded in the concrete. Ties shall not be removed in such manner as to leave a hole extending through the interior of the concrete members. The use of snap-ties which cause spilling of the concrete upon form stripping or tie removal will not be permitted. If steel panel forms are used, rubber grommets shall be provided where the ties pass through the form in order to prevent loss of cement paste. Where metal rods extending through the concrete are used to support or to strengthen forms, the rods shall remain embedded and shall terminate not less than 1 inch back from the formed face or faces of the concrete.

3.03 REUSE OF FORMS

- A. Forms may be reused only if in good condition and only if acceptable to the Engineer. Light sanding between uses will be required wherever necessary to obtain uniform surface texture on all exposed concrete surfaces. Exposed concrete surfaces are defined as surfaces which are permanently exposed to view.

3.04 REMOVAL OF FORMS

- A. Careful procedures for the removal of forms shall be strictly followed, and this work shall be done with care so as to avoid injury to the concrete. No heavy loading on green concrete will be permitted. Members which must support their own weight shall not have their forms removed until they have attained at least 75 percent of the 28-day strength of the concrete as specified herein. Forms for all vertical walls and columns shall remain in place at least 2 days after the concrete has been placed. Forms for all parts of the Work not specifically mentioned herein shall remain in place for periods of time as determined by the Engineer.

3.05 FABRICATION OF REINFORCING STEEL

- A. Reinforcing steel shall be accurately formed to the dimensions and shapes shown on the Drawings, and the fabricating details shall be prepared in accordance with ACI 315 and ACI 318, except as modified by the Drawings.
- B. Bending or Straightening: Reinforcement shall not be straightened or rebent in a manner which will injure the material. Bars with kinks or bends not shown shall not be used. All bars shall be bent cold, unless otherwise permitted by the Engineer. No bars partially embedded in concrete shall be field-bent except as shown or specifically permitted by the Engineer.

3.06 PLACING REINFORCING STEEL

- A. Reinforcing steel shall be accurately positioned as shown on the Drawings, and shall be supported and wired together to prevent displacement, using annealed iron wire ties or suitable clips at intersections. All reinforcing steel shall be supported by concrete, plastic or metal supports, spacers or metal hangers which are strong and rigid enough to prevent any displacement of the reinforcing steel. Where concrete is to be placed on the ground, supporting concrete blocks (or dobies) shall be used, in sufficient numbers to support the bars without settlement, but in no case shall such support be continuous. All concrete blocks used to support reinforcing steel shall be tied to the steel with wire ties which are embedded in the blocks. For concrete over formwork, the Contractor shall furnish concrete, metal, plastic, or other acceptable bar chairs and spacers.
- B. The portions of all accessories in contact with the formwork shall be made of concrete, plastic, or steel coated with a 1/8 inch minimum thickness of plastic which extends at least 1/2 inch from the concrete surface. Plastic shall be gray in color.
- C. Tie wires shall be bent away from the forms in order to provide the specified concrete coverage.

- D. Bars additional to those shown which may be found necessary or desirable by the Contractor for the purpose of securing reinforcement in position shall be provided by the Contractor at its own expense.
- E. Reinforcement placing tolerances shall be within the limits specified in ACI 318, unless otherwise directed by the Engineer.
- F. Welded wire fabric reinforcement placed over horizontal forms shall be supported on slab bolsters having gray, plastic-coated standard type legs as specified herein. Slab bolsters shall be spaced not less than 30 inches on centers, shall extend continuously across the entire width of the reinforcing mat, and shall support the reinforcing mat in the plane shown.
- G. Welded wire fabric placed over the ground shall be supported on wired concrete blocks (dobies) spaced not more than 3 feet on centers in any direction. The construction practice of placing welded wire fabric on the ground and hooking into place in the freshly placed concrete shall not be used.

3.07 SPLICING

- A. Reinforcement bar splices shall only be used at locations shown. When it is necessary to splice reinforcement at points other than where shown, the character of the splice shall be as acceptable to the Engineer.
- B. Lap length for reinforcement bars shall be in a Class B Splice in accordance with ACI 318, unless otherwise shown. Laps of welded wire fabric shall be in accordance with the ACI 318.

3.08 CLEANING AND PROTECTION OF REINFORCING STEEL

- A. Reinforcing steel shall at all times be protected from conditions conducive to corrosion until concrete is placed around it.
- B. The surfaces of all reinforcing steel and other metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar, and other foreign substances immediately before the concrete is placed. Where there is a delay in depositing concrete, reinforcing shall be reinspected and, if necessary, recleaned.

3.09 PREPARATION OF SURFACES FOR CONCRETING

- A. General: No concrete shall be placed until the reinforcement steel and formwork have been erected in a manner acceptable to the Engineer. The Contractor shall notify the Engineer not less than two working days prior to concrete placement, allowing for inspection and any corrective measures which are required. Earth surfaces shall be thoroughly wetted by sprinkling, prior to the placing of any concrete, and these surfaces shall be kept moist by frequent sprinkling up to the time of placing concrete thereon. The surface shall be free from standing water, mud, and debris at the time of placing concrete.

- B. Joints in Concrete: Concrete surfaces upon or against which concrete is to be placed, where the placement of the old concrete has been stopped or interrupted so that, as determined by the Engineer, the new concrete cannot be incorporated integrally with that previously placed, are defined as construction joints. The surfaces of horizontal joints shall be given a compacted, roughened surface for good bond. Except where the Drawings call for joint surfaces to be coated, the joint surfaces shall be cleaned of all laitance, loose or defective concrete, and foreign material. Such cleaning shall be accomplished by sandblasting, followed by thorough washing. All pools of water shall be removed from the surface of construction joints before the new concrete is placed.
- C. Existing concrete surfaces upon or against which concrete is to be placed shall be given a roughened surface for good bond. Joint surfaces shall be cleaned of all laitance, loose or defective concrete, and foreign material. Such cleaning shall be accomplished by hydroblasting. All pools of water shall be removed from the surface of construction joints before the new concrete is placed.
- D. Placing Interruptions: When placing of concrete is to be interrupted long enough for the concrete to take a set, the working face shall be given a shape by the use of forms or other means that will secure proper union with subsequent work, provided that construction joints shall be made only where acceptable to the Engineer.
- E. Embedded Items: No concrete shall be placed until all formwork, installation of parts to be embedded, reinforcement steel, and preparation of surfaces involved in the placing have been completed and accepted by the Engineer at least 4 hours before placement of concrete. All surfaces of forms and embedded items that have become encrusted with dried grout from concrete previously placed shall be cleaned of all such grout before the surrounding or adjacent concrete is placed.
- F. All reinforcement, anchor bolts, sleeves, inserts, and similar items shall be set and secured in the forms where shown on the Drawings or by shop drawings and shall be acceptable to the Engineer before any concrete is placed. Accuracy of placement is the responsibility of the Contractor.
- G. Casting Against Old Concrete: Where concrete is to be cast against old concrete (any concrete which is greater than 60 days of age), the surface of the old concrete shall be thoroughly cleaned and roughened by hydro-blasting (exposing aggregate) prior to the application of an epoxy bonding agent. Application shall be according to the bonding agent manufacturer's instructions and recommendations.
- H. No concrete shall be placed in any structure until all water entering the space to be filled with concrete has been properly cut off or has been diverted by pipes, or other means, and carried out of the forms, clear of the work. No concrete shall be deposited under water nor shall the Contractor allow still water to rise on any concrete until the concrete has attained its initial set. Water shall not be permitted to flow over the surface of any concrete in such manner and at such velocity as will injure the surface finish of the concrete. Pumping or other necessary dewatering operations for removing ground water, if required, will be subject to the review of the Engineer.

- I. Openings for pipes, inserts for pipe hangers and brackets, and the setting of anchors shall, where practicable, be provided for during the placing of concrete.
- J. Corrosion Protection: Pipe, conduit, dowels, and other ferrous items required to be embedded in concrete construction shall be so positioned and supported prior to placement of concrete that there will be a minimum of 2 inches clearance between said items, and any part of the concrete reinforcement will not be permitted.
- K. Cleaning: The surfaces of all metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar, and other foreign substances immediately before the concrete is placed.

3.10 MIXING, HANDLING, TRANSPORTING, AND PLACING

- A. General: Placing of concrete shall conform to the applicable requirements of Chapter 8 of ACI 301 and the requirements of this Section.
- B. Mixing: Mixing of concrete shall conform to the requirements of Chapter 7 of ACI 301.
- C. Retempering: Retempering of concrete or mortar which has partially hardened will not be permitted.
- D. Non-Conforming Work or Materials: Concrete which upon or before placing is found not to conform to the requirements specified herein shall be rejected and immediately removed from the Work. Concrete which is not placed in accordance with these Specifications, or which is of inferior quality, shall be removed and replaced by and at the expense of the Contractor.
- E. Unauthorized Placement: No concrete shall be placed except in the presence of duly authorized representative of the Owner. The Contractor shall notify the Engineer in writing at least 24 hours in advance of placement of any concrete.
- F. Placement in Slabs: Concrete placed in sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the pour. As the work progresses, the concrete shall be vibrated and carefully worked around the slab reinforcement, and the surface of the slab shall be screened in an up-slope direction.
- G. Placement in Wall Forms: Concrete shall not be dropped through reinforcement steel or into any deep form, whether reinforcement is present or not, causing separation of the coarse aggregate from the mortar on account of repeatedly hitting rods or the sides of the form as it falls, nor shall concrete be placed in any form in such a manner as to leave accumulation of mortar on the form surfaces above the placed concrete. In such cases, some means such as the use of hoppers and, if necessary, vertical ducts of canvas, rubber, or metal shall be used for placing concrete in the forms in a manner that it may reach the place of final deposit without separation. In no case shall the free fall of concrete exceed 4 feet below the ends of ducts, chutes, or buggies. Concrete shall be uniformly distributed during the process of depositing, and in no case after depositing shall any portion be displaced in the forms more than 6 feet in horizontal direction. Concrete in forms shall be deposited in uniform horizontal layers not deeper than 2 feet; and care shall

be taken to avoid inclined layers or inclined construction joints where such are required for sloping members. Each layer shall be placed while the previous layer is still soft. The rate of placing concrete in forms shall not exceed 5 feet of vertical rise per hour.

- H. The surface of the concrete -shall be level whenever a run of concrete is stopped. To insure a level, straight joint on the exposed surface of walls, a wood strip at least 3/4 inch thick shall be tacked to the forms on these surfaces. The concrete shall be carded about 1/2 inch above the underside of the strip. About one hour after the concrete is placed, the strip shall be removed and any irregularities in the edge formed by the strip shall be leveled with a trowel and all laitance shall be removed.
- I. Conveyor Belts and Chutes: All end of chutes, hopper gates and all other points of concrete discharge throughout the Contractor's conveying, hoisting and placing system shall be so designed and arranged that concrete passing from them will not fall separated into whatever receptacle immediately receives it. Conveyor belts, if used, shall be of a type acceptable to the Engineer. Chutes longer than 50 feet will not be permitted. Minimum slopes of chutes shall be such that concrete of the specified consistency will readily flow in them. If a conveyor belt is used, it shall be wiped clean by a device operated in such a manner that none of the mortar adhering to the belt will be wasted. All conveyor belts and chutes shall be covered. Sufficient illumination shall be provided in the interior of all forms so that the concrete, at the places of deposit, is visible from the deck or runway.
- J. Temperature of Concrete: The temperature of concrete, when it is being placed, shall not be more than 90 degrees F nor less than 40 degrees F in moderate weather, and not less than 50 degrees F in whether during which the mean daily temperature drops below 40 degrees F. Concrete ingredients shall not be heated to a temperature higher than that necessarily to keep the temperature of the mixed concrete, as placed, from falling below the specified minimum temperature. If concrete is placed when the weather is such that the temperature of the concrete would exceed 90 degrees F, the Contractor shall employ effective means, such as precooling of aggregates and mixing water using ice or placing at night, as necessary to maintain the temperature of the concrete, as it is placed, below 90 degrees F. The Contractor shall be entitled to no additional compensation on account of the foregoing requirements.

3.11 PUMPING OF CONCRETE

- A. If the pumped concrete does not produce satisfactory end results, the Contractor shall discontinue the pumping operation and proceed with the placing of concrete using conventional methods.
- B. The minimum diameter of the hose (conduits) shall be 4 inches.
- C. Minimum compressive strength, cement content, and maximum size of aggregates shall be as specified herein. Gradation of coarse aggregates shall conform to ASTM C 33 and shall be as close to the middle range as possible. Gradation of fine aggregate shall conform to ASTM C 33, with 15 to 30 percent passing the number 50 screen and 5 to 10 percent passing the number 100 screen. The fineness modulus of sand shall not be over 3.00.

3.12 TAMPING AND VIBRATING

- A. As concrete is placed in the forms or in excavations, it shall be thoroughly settled and compacted, throughout the entire depth of the layer which is being consolidated, into a dense homogeneous mass, filling all corners and angles, thoroughly embedding the reinforcement, eliminating rock pockets, and bringing only a slight excess of water to the exposed surface of concrete during placement. Vibrators shall be high speed power vibrators (8,000 or 10,000 rpm) of an immersion type in sufficient number and with (at least one) standby units as required.
- B. Concrete in walls shall be internally vibrated and at the same time rammed, stirred, or worked with suitable appliances, tamping bars, shovels, or forked tools until it completely fills the forms or excavations and closes snugly against all surfaces. Subsequent layers of concrete shall not be placed until the layers previously placed have been worked thoroughly as specified. Vibrators shall be provided in sufficient numbers, with standby units as required, to accomplish the results herein specified with 15 minutes after concrete of the prescribed consistency is placed in the forms. The vibrating head shall be kept from contact with the surfaces of the forms. Care shall be taken not to vibrate concrete excessively or to work it in any manner that causes segregation of its constituents.

3.13 FINISHING CONCRETE SURFACES

- A. General: Surfaces shall be free from fins, bulges, ridges, offsets, honeycombing, or roughness of any kind, and shall present a finished, smooth, continuous hard surface. Allowable deviations from plumb or level and from the alignment, profiles, and dimensions shown on the Drawings are defined as tolerances and are specified herein. These tolerances are to be distinguished from irregularities in finish as described herein. Aluminum finishing tools shall not be used.
- B. Formed Surfaces: After removal of forms, the finishes described below shall be applied in accordance with Article 3.13, D. Unless the finish schedule specifies otherwise, all surfaces shall receive at least a Type I finish. The Engineer shall be the sole judge of acceptability of all concrete finish work.
 - 1. Type I - Rough: All fins, burrs and other projections left by the forms shall be removed. All holes left by removal of ends of ties, and all other holes, depressions, or voids shall be filled solid with cement grout after first being thoroughly wetted. Honeycombs shall be chipped back to solid concrete as directed, prior to patching with cement grout. Holes shall be filled with a small tool that will permit packing the hole solidly with cement grout. Cement grout shall consist of one part cement to three parts sand, and the amount of mixing water shall be as little as consistent with the requirements of handling and placing. Color of cement grout shall match the adjacent wall surface. At locations where concrete coatings are specified to be applied, epoxy based patch material or filler surfaces compatible with the coating shall be used in lieu of cement grout specified herein. Concrete finish shall be in strict conformance to the coating / paint manufacturer's recommendations.

2. Type II - Grout Cleaned: Where this finish is required, it shall be applied after completion of Type I finish. After the concrete has been predampened, slurry consisting of one part cement (including an appropriate quantity of white cement in order to produce a color matching the surrounding concrete) and 1-1/2 parts sand passing the No. 16 sieve, by damp loose volume, shall be spread over the surface with clean burlap pads or sponge rubber floats. Any surplus shall be removed by scraping and then rubbing with clean burlap. The finish shall be kept damp for at least 36 hours after application.
 3. Type III - Smooth Rubbed: Where this finish is required, it shall be applied after the completion of the Type I finish. No rubbing shall be done before the concrete is thoroughly hardened and the mortar used for patching is firmly set. A smooth, uniform surface shall be obtained by wetting the surface and rubbing it with a carborundum stone to eliminate irregularities. Unless the nature of the irregularities requires it, the general surface of the concrete shall not be cut into. Corners and edges shall be slightly rounded by the use of the carborundum stone. Brush finishing or painting with grout or neat cement will not be permitted.
- C. Unformed Surfaces: The finishes described below shall be applied to unformed surfaces such as floors, slabs, flow channels and top of walls in accordance with Article 3.05 - Concrete Finish Schedule. The Engineer shall be the sole judge of acceptability of all such finish work.
1. Type "A" - Screeded: This finish shall be obtained by placing screeds at frequent intervals and striking off to the surface elevation required. When a Type "F" finish is subsequently to be applied, the surface of the screeded concrete shall be roughened with a concrete rake to ½" minimum deep grooves prior to final set.
 2. Type "B" - Wood Floated: This finish shall be obtained after completion of a Type "A" finish by working a previously screeded surface with a wood float until the desired texture is reached. Floating shall begin when the water sheen has disappeared and when the concrete has sufficiently hardened so that a person's foot leaves only a slight imprint. If wet spots occur, water shall be removed with a squeegee. Care shall be taken to prevent the formation of laitance and excess water on the finished surface. The finished surface shall be true, even, and free from blemishes and other irregularities.
 3. Type "C" - Cork Floated: This finish shall be similar to Type "B" but slightly smoother than that obtained with a wood float. It shall be obtained by power or band floating with cork floats.
 4. Type "D" - Steel Troweled: This finish shall be obtained after completion of a Type "B" finish. When the concrete has hardened sufficiently to prevent excess fine material from working to the surface, the surface shall be compacted and smoothed with not less than two thorough and complete steel troweling operations. In areas, which are to receive a floor covering such as tile, resilient flooring, or carpeting, only one troweling operation is required. The finish shall be brought to a smooth, dense surface, free from defects and blemishes.

5. Type "E" - Broom or Belt: This finish shall provide the surface with a transverse scored texture by drawing a broom or burlap belt across the surface immediately after completion of a Type "B" finish.
6. Type "F" - Swept in Grout Topping: This finish shall be applied after a completion of a Type "A" finish. The concrete surface shall be properly cleaned, washed, and coated with a mixture of water and Portland Cement. Cement grout in accordance with Section 03315 shall then be plowed and swept into neat conformance with the blades or arms of the apparatus by turning or rotating the previously positioned mechanical equipment. Special attention shall be paid to true grades, shapes and tolerances as specified by the manufacturer of the equipment. Before beginning this finish, the Contractor shall notify the Engineer and the equipment manufacturer of the details of the operation and obtain approval and recommendations of the equipment manufacturer.
7. Type "G" - Hardened Finish: Either a liquid hardened finish or an aggregate hardened finish shall be provided at the Contractor's option.
 - a. Liquid hardened finish shall be provided by application of a liquid floor hardener. Floors to receive this finish shall have previously received a Type "D" finish. Liquid hardener shall be applied between 30 to 60 days after concrete placement. Surface to be treated shall be dry, clean and free of all loose dust, dirt, oil, wax, sealers and curing compounds. Application procedure shall be in accordance with manufacturer's instructions and shall consist of a three-coat treatment.
 - b. Aggregate hardened finish shall be provided by applying an aggregate floor hardener concurrently with the application of a Type "D" finish. Application procedure shall be in accordance with manufacturer's instructions.
8. Type "H" - Non-Slip Finish: This finish shall be provided by applying a non-slip shake-on aggregate concurrently with the application of a Type "D" finish. Application procedure shall be in accordance with manufacturer's instructions.
9. Type "J" - Raked Finish: This finish shall be provided by raking the surface as soon as the condition of the concrete permits by making depressions of +/-1/4-inch.

D. CONCRETE FINISH SCHEDULE

Item	Type of Finish
Inner face of walls of tanks, flow channels, wet wells, perimeter walls, and miscellaneous structures to be coated in accordance with the Section entitled "Painting"	I
Exterior concrete walls below grade	I
Exterior exposed concrete walls and columns (including top of wall) to one foot below grade. All other exposed concrete surfaces not specified elsewhere	II

Item	Type of Finish
All interior exposed concrete vertical surfaces in buildings	III
Interior exposed ceiling, including beams	III
Floors of process equipment tanks or basins, and slabs to receive roofing material or waterproof membranes	B
All interior finish floors of buildings and structures and walking surfaces which will be continuously or intermittently wet	C
All interior finish floors of buildings and structures which are not continuously or intermittently wet	D
Floors to receive tile, resilient flooring, or carpeting	D
Concrete in flow channels not specified to be coated	D
Exterior concrete sidewalks, steps, ramps, decks, slabs on grade and landings exposed to weather	E
Floors of process tanks indicated on Drawings or in the specifications to receive cement grout topping	F
Precast concrete form panels, hollow core planks, double tees	J

3.14 CURING AND DAMPPROOFING

- A. All concrete shall be cured for not less than 14 days after placing, in accordance with the methods specified herein for the different parts of the work, and described in detail in the following paragraphs.

FINISH SCHEDULE

<u>Surface to be Cured or Dampproofed</u>	<u>Method</u>
Unstripped forms	1
Construction joints between footings and walls, and between floor slab and columns	2
Encasement concrete and thrust blocks	3
All concrete surfaces not specifically provided for elsewhere in this Paragraph	4

- B. Method 1: Wooden forms shall be wetted immediately after concrete has been placed and shall be kept wet with water until removed. If steel forms are used, the exposed concrete surfaces shall be kept continuously wet until the forms are removed. If forms are removed within 14 days of placing the concrete, curing shall be continued in accordance with Method 4.

- C. Method 2: The surface shall be covered With burlap mats which shall be kept wet with water for the duration of the curing period, until the concrete in the walls has been placed. No curing compound shall be applied to surfaces cured under Method 2.
- D. Method 3: The surface shall be covered with moist earth not less than 4 hours, nor more than 24 hours, after the concrete is placed. Earthwork operations that may damage the concrete shall not begin until at least 7 days after placement of concrete.
- E. Method 4: The surface shall be sprayed with a liquid curing compound. It shall be applied in accordance with the manufacturers printed instructions at a maximum coverage rate of 200 square feet per gallon and in such a manner as to cover the surface with a uniform film which will seal thoroughly.
- F. Care shall be exercised to avoid damage to the seal during the curing period. Should the seal be damaged or broken before the expiration of the curing period, the break shall be repaired immediately by the application of additional curing compound over the damaged portion.
- G. Wherever curing compound may have been applied by mistake to faces against which concrete subsequently is to be placed and to which it is to adhere, said compound shall be entirely removed by hydroblasting just prior to the placing of new concrete.
- H. Curing compound shall be applied as soon as the concrete has hardened enough to prevent marring on uniformed surfaces, and within 2 hours after removal of forms from contact with formed surfaces. Repairs required to be made to formed surfaces shall be made within the said 2-hour period; provided, however, that any such repairs which cannot be made within the said 2-hour period shall be delayed until after the curing compound has been applied. When repairs are to be made to an area on which curing compound has been applied, the area involved shall first be wet-sandblasted to remove the curing compound, following which repairs shall be made as provided herein.

3.15 PROTECTION

- A. The Contractor shall protect all concrete against injury until final acceptance by the Engineer. Fresh concrete shall be protected from damage due to rain. The Contractor shall provide such protection while the concrete is still plastic and whenever such precipitation is imminent or occurring.

3.16 TREATMENT OF SURFACE DEFECTS

- A. As soon as forms are removed, all exposed surfaces shall be carefully examined and any irregularities shall be immediately rubbed or ground in a satisfactory manner in order to secure a smooth, uniform, and continuous surface. Plastering or coating of surfaces to secure a smooth, uniform, and continuous surface. Plastering or coating of surfaces to be smoothed will not be permitted. No repairs shall be made until after inspection by the Engineer. In no case will extensive patching of honeycombed concrete be permitted.

Concrete containing minor voids, holes, honeycombing, or similar depression defects shall have them repaired as specified herein. Concrete containing extensive voids, holes, honeycombing, or similar depression defects, shall be completely removed and replaced. All repairs and replacements herein specified shall be promptly executed by the Contractor at its own expense.

- B. Defective surfaces to be repaired shall be cut back from trueline a minimum depth of 1/2 inch over the entire area. Feathered edges will not be permitted. Where chipping or cutting tools are not required in order to deepen the area properly, the surface shall be prepared for bonding by the removal of all laitance or soft material, and not less than 1/32 inch depth of the surface film from all hard portions, by means of an efficient sandblast. The material used for repair proposed shall be acceptable to the Engineer.
- C. Holes left by tie-rod cones shall be reamed with suitable toothed reamers so as to leave the surfaces of the holes clean and rough. These holes then shall be repaired in an approved manner with dry-packed cement grout. Holes left by form-tying devices having a rectangular cross-section, and other imperfections having a depth greater than their least surface dimension, shall not be reamed, but shall be repaired in an approved manner with dry-packed cement grout.
- D. All repairs shall be built up and shaped in such a manner that the completed work will conform to the requirements of this Section, using approved methods which will not disturb the bond, cause sagging, or cause horizontal fractures. Surfaces of said repairs shall receive the same kind and amount of curing treatment as required for the concrete in the repaired section.

3.17 CARE AND REPAIR OF CONCRETE

- A. The Contractor shall protect all concrete against injury or damage from excessive heat, lack of moisture, overstress, or any other cause until final acceptance by the Owner. Particular care shall be taken to prevent the drying of concrete and to avoid roughening or otherwise damaging the surface. Any concrete found to be damaged, or which may have been originally defective, or which becomes defective at any time prior to the final acceptance of the completed work, or which departs from the established line or grade, or which, for any other reason, does not conform to the requirements of the Contract Documents, shall be satisfactorily repaired or removed and replaced with acceptable concrete at the Contractor's expense. This stipulation includes concrete experiencing cracking due to drying or thermal shrinkage of the concrete. Structural cracks shall be repaired using an epoxy injection system approved by the Engineer. Non-structural cracks shall be repaired using a hydrophilic resin pressure injected grout system approved by the Engineer, unless other means or repair are deemed necessary and approved by the Engineer.

3.18 GROUT INSTALLATION

- A. All surface preparation, curing, and protection of cement grout shall be as specified herein. The finish of the grout surface shall match that of the adjacent concrete.

- B. The Contractor through the manufacturer of non-shrink grout shall provide on-site technical assistance upon request, at no additional cost to the Owner.
- C. All mixing, surface preparation, handling, placing, consolidation, and other means of execution for prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.
- D. Grout shall be placed in such a manner, for the consistency necessary for each application, so as to assure that the space to be grouted is completely filled.

- END OF SECTION -

SECTION 05010 - METAL MATERIALS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Metal materials not otherwise specified shall conform to the requirements of this Section.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Materials for fasteners shall be as specified in the Section entitled "Metal Fastening".
- B. Requirements for specific products made from the materials specified herein are included in other sections of the Specifications. See the section for the specific item in question.

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

ASTM A36	Standard Specification for Structural Steel
ASTM A47	Standard Specification for Malleable Iron Castings
ASTM A48	Standard Specification for Gray Iron Castings
ASTM A53	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A167	Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A276	Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes
ASTM A307	Standard Specification for Carbon Steel Externally Threaded Standard Fasteners
ASTM A446	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality
ASTM A500	Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A501	Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A529	Standard Specification for Structural Steel with 42 000 psi (290 Mpa) Minimum Yield Point (1/2 in. (12.7 mm) Maximum Thickness)
ASTM A536	Standard Specification for Ductile Iron Castings
ASTM A570	Standard Specification for Hot-Rolled Carbon Steel Sheet and Strip, Structural Quality
ASTM A572/A572M-94C	Standard Specification for High Strength Low-Alloy Columbium-Vanadium Structural Steel Grade 50
ASTM A666	Standard Specification for Austenitic Stainless Steel, Sheet, Strip, Plate, and Flat Bar for Structural Applications

ASTM A992	Standard Specification for Structural Steel Shapes
ASTM B26	Standard Specification for Aluminum-Alloy Sand Castings
ASTM B85	Standard Specification for Aluminum-Alloy Die Castings
ASTM B108	Standard Specification for Aluminum-Alloy Permanent Mold Castings
ASTM B138	Standard Specification for Manganese Bronze Rod, Bar, and Shapes
ASTM B209	Standard Specification for Aluminum-Alloy Sheet and Plate
ASTM B221	Standard Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes
ASTM B308	Standard Specification for Aluminum-Alloy Standard Structural Shapes, Rolled or Extruded
ASTM B574	Standard Specification for Nickel-Molybdenum-Chromium Alloy Rod
ASTM F468	Standard Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use

1.04 SUBMITTALS

- A. Material certifications shall be submitted along with any shop drawings for metal products and fabrications required by other sections of the Specifications.

1.05 QUALITY ASSURANCE

- A. Owner may engage the services of a testing agency to test any metal materials for conformance with the material requirements herein. If the material is found to be in conformance with Specifications the cost of testing will be borne by the Owner. If the material does not conform to the Specifications, the cost of testing shall be paid by the Contractor and all materials not in conformance as determined by the Engineer shall be replaced by the Contractor at no additional cost to the Owner. In lieu of replacing materials the Contractor may request further testing to determine conformance, but any such testing shall be paid for by the Contractor regardless of outcome of such testing.

PART 2 -- PRODUCTS

2.01 CARBON AND LOW ALLOY STEEL

- A. Material types and ASTM designations shall be as listed below:
 1. Structural W Shapes A 992 (50 ksi)
 2. Structural S, M, C, L Shapes A 36 (36 ksi)
 3. Structural HP shape A 572, Grade 50 (50 ksi)
 4. Structural Tubing A 500, Grade B or A 501 (42 ksi)
 5. Structural Pipe A 53, Type E or S, Grade B (35 ksi)
 6. Plates and Bars A 36 U.N.O. (36 ksi)

- | | | |
|----|---|----------------|
| 7. | Sheet Steel | A 570, Grade C |
| 8. | Cold-Formed Structural Studs and Joists (18-22 gauge) | A 446, Grade C |
| 9. | Cold-Formed Structural Studs and Joists (12-16 gauge) | A 446 Grade D |

2.02 STAINLESS STEEL

- A. All stainless steel fabrications shall be Type 316.
- B. Material types and ASTM designations are listed below:
- | | | |
|----|-------------------|---------------------------|
| 1. | Plates and Sheets | ASTM A167 or A666 Grade A |
| 2. | Structural Shapes | ASTM A276 |

2.03 ALUMINUM

- A. All aluminum shall be alloy 6061-T6, unless otherwise noted or specified herein.
- B. Material types and ASTM designations are listed below:
- | | | |
|----|---------------------------------|------------------------|
| 1. | Structural Shapes | ASTM B308 |
| 2. | Castings | ASTM B26, B85, or B108 |
| 3. | Extruded Bars | ASTM B221 - Alloy 6061 |
| 4. | Extruded Rods, Shapes and Tubes | ASTM B221 - Alloy 6063 |
| 5. | Plates | ASTM B209 - Alloy 6061 |
| 6. | Sheets | ASTM B221 - Alloy 3003 |
- C. All aluminum structural members shall conform to the requirements of the Section entitled "Structural Aluminum".
- D. All aluminum shall be provided with mill finish unless otherwise noted.
- E. Where bolted connections are indicated, aluminum shall be fastened with Type 316 stainless steel bolts.
- F. Aluminum in contact with dissimilar materials shall be insulated with an approved dielectric.

2.04 CAST IRON

- A. Material types and ASTM designations are listed below:
- | | | |
|----|-----------|--------------------------|
| 1. | Gray | ASTM A48 Class 30B |
| 2. | Malleable | ASTM A47 |
| 3. | Ductile | ASTM A536 Grade 60-40-18 |

2.05 BRONZE

A. Material types and ASTM designations are listed below:

1. Rods, Bars and Sheets

ASTM B138 - Alloy B Soft

2.06 HASTELLOY

A. All Hastelloy shall be Alloy C-276.

PART 3 – EXECUTION (NOT USED)

- END OF SECTION –

SECTION 05050 - METAL FASTENING

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. Furnish all materials, labor, and equipment required to provide all metal welds and fasteners not otherwise specified, in accordance with the Contract Documents.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. Florida Building Code
2. AISC Specification for Structural Joints Using ASTM A325 or A490 Bolts.
3. AISC Code of Standard Practice
4. AWS D1.1 Structural Welding Code - Steel
5. AWS D1.2 Structural Welding Code - Aluminum
6. Aluminum Association Specifications for Aluminum Structures
7. ASTM A572/A572M-94C Standard Specification for High Strength Low-Alloy Columbium-Vanadium Structural Steel Grade 50
8. ASTM A307 Standard Specification for Carbon Steel Externally Threaded Standard Fasteners
9. ASTM A325 Standard Specification for High-Strength Bolts for Structural Steel Joints
10. ASTM A489 Standard Specification for Eyebolts
11. ASTM A490 Standard Specification for Quenched and Tempered Alloy Steel Bolts for Structural Steel Joints
12. ASTM A563 Standard Specifications for Carbon and Alloy Steel Nuts
13. ASTM F593 Standard Specification for Stainless Steel Bolts; Hex Cap Screws, and Studs
14. ASTM F594 Standard Specification for Stainless Steel Nuts
15. ASTM D1785 Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe
16. ASTM F467 Standard Specification for Nonferrous Nuts for General Use

1.04 SUBMITTALS

- A. Submit the following in accordance with the Section entitled "Submittals".
 - 1. Shop Drawings providing the fastener's manufacturer and type and certification of the fastener's material and capacity.
 - 2. Manufacturer's installation instructions.
 - 3. Copy of valid certification for each person who is to perform field welding.
 - 4. Certified weld inspection reports, when required.
 - 5. Welding procedures.
 - 6. For outdoor equipment, anchorage calculations to resist design wind loads, signed and sealed by a Professional Engineer registered in the State of Florida.

1.05 QUALITY ASSURANCE

- A. Fasteners not manufactured in the United States shall be tested and certification provided with respect to specified quality and strength standards. Certifications of origin shall be submitted for all U.S. fasteners supplied on the project.
- B. Installer Qualifications: Drilled-in anchors shall be installed by an Installer with at least three years of experience performing similar installations. Installer shall be certified as an Adhesive Anchor Installer in accordance with ACI-CRSI Adhesive Anchor Installation Certification Program.
- C. Installer Training: Conduct a thorough training with the manufacturer or the manufacturer's representative for the Installer on the project. Training shall consist of a review of the complete installation process for drilled-in anchors, to include but not be limited to the following:
 - 1. Hole drilling procedure.
 - 2. Hole preparation and cleaning technique.
 - 3. Adhesive injection technique and dispenser training/maintenance.
 - 4. Rebar doweling preparation and installation.
 - 5. Proof loading/torquing.
- D. All steel welding shall be performed by welders certified in accordance with AWS D1.1. All aluminum welding shall be performed by welders certified in accordance with AWS D1.2. Certifications of field welders shall be submitted prior to performing any field welds.
- E. Welds and high strength bolts used in connections of structural steel will be visually inspected in accordance with Article 3.04.
- F. The Owner may engage an independent testing agency to perform testing of welded connections and to prepare test reports in accordance with AWS. Inadequate welds shall be corrected or redone and retested to the satisfaction of the Engineer and/or an acceptable independent testing laboratory, at no additional cost to the Owner.
- G. Provide a welding procedure for each type and thickness of weld. For welds that are not prequalified, include a Performance Qualification Report. The welding procedure shall be

given to each welder performing the weld. The welding procedure shall follow the format in Annex E of AWS D1.1 with relevant information presented.

PART 2 - PRODUCTS

2.01 ANCHOR RODS (ANCHOR BOLTS)

- A. Unless shown otherwise on the Drawings, all anchor bolts shall be Type 316 stainless steel conforming to ASTM F-593.
- B. Anchor bolts for the pump bases shall be sized and furnished by the pump manufacturer. Materials for pump base anchor bolts shall be selected by the pump manufacturer.
- C. Nuts shall conform to ASTM F-594, alloy 316.
- D. Where anchor rods are used to anchor galvanized steel or are otherwise specified to be galvanized, anchor rods and nuts shall be hot-dip galvanized in accordance with ASTM F1554.
- E. Where pipe sleeves around anchor rods are shown on the Drawings, pipe sleeves shall be cut from Schedule 80 PVC plastic piping meeting the requirements of ASTM D1785, unless noted otherwise.
- F. Equipment manufacturers, fabricators, and suppliers shall design and furnish anchor bolts as required to install the supplied units. The anchor bolt layout shall be coordinated with concrete work as specified herein.
- G. Drilled in type anchor bolts, either adhesive types or mechanical types shall not be used unless approved in writing by the manufacturer/fabricator of equipment or covers, subject to acceptance by the ENGINEER. All operating pieces of equipment such as pumps, generators, motors etc. shall not be anchored with wedge anchors or other mechanical anchors. Drilled in type anchor bolts shall be Type 316 stainless steel. Drilled in type anchor bolts are specified under Article 2.04 of this Section entitled "Concrete Anchors".

2.02 HIGH STRENGTH BOLTS

- A. High strength bolts and associated nuts and washers shall be in accordance with ASTM A325 or ASTM A490. Bolts, nuts and washers shall meet the requirements of AISC "Specification for Structural Joints Using ASTM A325 or A490 Bolts".
- B. Where high strength bolts are used to connect galvanized steel or are otherwise specified to be galvanized, bolts, nuts, and washers shall be hot-dip galvanized in accordance with ASTM A325.

2.03 STAINLESS STEEL BOLTS

- A. Stainless steel bolts shall conform to ASTM F-593. All underwater fasteners shall be Type 316 stainless steel. Unless otherwise specified, fasteners for aluminum and stainless steel members shall be Type 316 stainless steel.
- B. Stainless steel bolts shall have hexagonal heads with a raised letter or symbol on the bolts indicating the manufacturer, and shall be supplied with hexagonal nuts meeting the requirements of ASTM F594. Nuts shall be of the same alloy as the bolts.

2.04 CONCRETE ANCHORS

- A. Where concrete anchors are called for on the Drawings, one of the types listed below shall be used; except, where one of the types listed below is specifically called for on the Drawings, only that type shall be used. Unless otherwise noted, all concrete anchors which are submerged, or which are subject to vibration from equipment such as pumps and generators, shall be adhesive anchors. The determination of anchors equivalent to those listed below shall be on the basis of test data performed by a commercial testing laboratory. There are two types used:
 - 1. Expansion anchors shall be wedge, sleeve, or drop-in mechanical anchors.
 - 2. Adhesive anchors shall be two part injection type.
- B. All concrete anchors shall be considered structural anchors that transmit load between structural elements and/or life-safety related attachments. Expansion anchors shall be recommended by the anchor manufacturer for use in cracked concrete and shall be evaluated according to ACI 355.2 Qualifications of Post-Installed Mechanical Anchors in Concrete. Adhesive anchors shall be tested in accordance with the ICC Evaluation Service acceptance criteria to be creep resistant and capable of resisting long-term tensile loads.
- C. Wedge anchors shall be "Kwik Bolt TZ" by Hilti, Inc., "Trubolt Wedge Anchor or TruBolt + " by ITW Redhead, "Strong-Bolt" by Simpson Strong-Tie Co. or "Powerstud SD-1" by Powers Fasteners. Sleeve anchors shall be "HSL/HSL-3 Heavy Duty Sleeve Anchors" by Hilti, Inc. "Power-Bolt" by Powers Fasteners or "Prima High Expansion/Heavy Duty Sleeve Anchor" by ITW Redhead. Drop-in anchors shall be "Drop-In" by Simpson Strong-Tie Co. or "Multi-Set II Drop-In Anchor" by ITW Redhead. Undercut anchors shall be "HDA Undercut Anchor" by Hilti, Inc. All anchors shall be embedded to the depths shown on the Drawings. If no embedment depth is given, the minimum embedment depth as recommended by the manufacturer shall be used. Expansion anchors shall not be used to hang items from above or in any other situations where direct tension forces are induced in anchor.
- D. Adhesive anchors shall consist of threaded rods or bolts anchored with an adhesive system into hardened concrete or grout-filled masonry. The adhesive system shall use a two-component adhesive mix and shall be injected with a static mixing nozzle following manufacturer's instructions. All holes shall be drilled with a carbide bit unless otherwise recommended by the manufacturer. Thoroughly clean drill holes of all debris and drill dust with compressed air followed by a wire brush prior to installation of adhesive and threaded rod/bolt. Where depth of hole exceeds the length of the static mixing nozzle, a plastic extension hose shall be used to ensure proper adhesive injection from the back of the hole. Injection of adhesive into the hole shall utilize a piston plug to minimize the formation of air pockets. Wipe rod free from oil that may be present from shipping or handling. The embedment depth of the rod/bolt shall provide a minimum allowable bond strength that is equal to the allowable tensile capacity of the rod/bolt unless noted otherwise on the Drawings. The adhesive system shall be "Epcon System G5" as manufactured by ITW Redhead, "SET-XP" as manufactured by Simpson Strong-Tie Co., or "PE-1000 SD" by Power Fasteners.

- E. Alternate adhesive systems shall be IBC compliant for use in both cracked and un-cracked concrete, must comply with the latest revision of ICC-ES Acceptance Criteria AC308, and shall have a valid ICC-ES report in accordance with the building code. Installation of adhesive system shall be per manufacturer's recommendations and as required in Item D above.
- F. Concrete anchors used to anchor steel shall be a threaded steel rod per manufacturer's recommendations for proposed adhesive system, but shall not have a yield strength (fy) less than 58 ksi nor an ultimate strength (fu) less than 72.5 ksi, unless noted otherwise. All concrete anchors shall be Type 316 stainless steel except where steel to be anchored is galvanized, concrete anchors shall also be galvanized.
- G. Anchor bolts and threaded rod for the chlorine diffuser shall be Hastelloy C-276.

2.05 MASONRY ANCHORS

- A. Anchors for fastening to solid or grout-filled masonry shall be adhesive anchors as specified above for concrete anchors.
- B. Anchors for fastening to hollow masonry or brick shall be adhesive anchors consisting of threaded rods or bolts anchored with an adhesive system dispensed into a screen tube inserted into the masonry. The adhesive system shall use a two-component adhesive mix and shall inject into the screen tube with a static mixing nozzle. Thoroughly clean drill holes of all debris and drill dust with nylon (not wire) brush prior to installation of adhesive and anchor. The Contractor shall follow manufacturer's installation instructions. The adhesive system shall be "Epcon System A7 or C6" as manufactured by ITW Ramset/Redhead, "SET/ET Epoxy-Tie" or "AT Acrylic-Tie" as manufactured by Simpson Strong-Tie Co., or "AC-100 Gold SD by Powers Fasteners.
- C. Masonry anchors used to anchor steel shall be of Type 316 stainless steel unless noted otherwise.
- D. Masonry anchors used to anchor aluminum, FRP, or stainless steel shall be Type 316 stainless steel unless noted otherwise. All underwater anchors shall be Type 316 stainless steel.

2.06 WELDS

- A. Electrodes for welding structural steel and all ferrous steel shall comply with AWS Code, using E70 series electrodes for shielded metal arc welding (SMAW), or F7 series electrodes for submerged arc welding (SAW).
- B. Electrodes for welding aluminum shall comply with the Aluminum Association Specifications and AWS D1.2.
- C. Electrodes for welding stainless steel and other metals shall comply with AWS code.

2.07 WELDED STUD CONNECTORS

- A. Welded stud connectors shall conform to the requirements of AWS D1.1 Type C.

2.08 EYEBOLTS

- A. Eyebolts shall conform to ASTM A489 unless noted otherwise.

2.09 HASTELLOY FASTENERS

- A. Hastelloy fasteners and nuts shall be constructed of Hastelloy C-276.

2.10 ANTI-SEIZE LUBRICANT

- A. Antiseize lubricant shall be Graphite 50 Anti-Seize by Loctite Corporation, 1000 Anti-Seize Paste by Dow Corning, 3M Lube and Anti-Seize by 3M, or equal.

PART 3 -- EXECUTION

3.01 MEASUREMENTS

- A. The Contractor shall verify all dimensions and review the Drawings and shall report any discrepancies to the Engineer for clarification prior to starting fabrication.

3.02 BOLT INSTALLATION

A. Anchor Bolts, Concrete Anchors, and Masonry Anchors

1. Anchor bolts shall be installed in accordance with AISC "Code of Standard Practice" by setting in concrete while it is being placed and positioned by means of a rigidly held template.
2. The Contractor shall verify that all concrete and masonry anchors have been installed in accordance with the manufacturer's recommendations and that the capacity of the installed anchor meets or exceeds the specified safe holding capacity.
3. Concrete anchors shall not be used in place of anchor bolts without Engineer's approval.
4. All stainless steel threads shall be coated with antiseize lubricant.

B. High Strength Bolts

1. All bolted connections for structural steel shall use high strength bolts. High strength bolts shall be installed in accordance with AISC "Specification for Structural Joints, using A325 or A490 Bolts." All high strength bolts installed by the "turn-of-nut" method shall have the turned portion marked with reference to the steel being connected after the nut has been made snug and prior to final tightening. These marks will be considered in inspection.
2. All stainless steel bolts shall be coated with antiseize lubricant.

C. Other Bolts

1. All dissimilar metal shall be connected with appropriate fasteners and shall be insulated with a dielectric or approved equal. Unless otherwise specified, where aluminum and steel members are connected together they shall be fastened with Type 316 stainless steel bolts and insulated with micarta, nylon, rubber, or equal.

3.03 WELDING

- A. All welding shall comply with AWS Code for procedures, appearance, quality of welds, qualifications of welders and methods used in correcting welded work.
- B. Welded stud connectors shall be installed in accordance with AWS D1.1.

3.04 INSPECTION

- A. High strength bolting will be visually inspected in accordance with AISC "Specification for Structural Joints Using A325 or A490 Bolts." Rejected bolts shall be either replaced or retightened as required. In cases of disputed bolt installation, the bolts in question shall be checked by a calibrated wrench certified by an independent testing laboratory. The certification shall be at the Contractor's expense.
- B. Field welds will be visually inspected in accordance with AWS Codes. Inadequate welds shall be corrected or redone as required in accordance with AWS Codes.

- END OF SECTION -

SECTION 05140 - STRUCTURAL ALUMINUM

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish all equipment, labor, materials, and services required to provide all structural aluminum work in accordance with the Contract Documents. The term "structural aluminum" shall include items as defined in the Aluminum Association "Specifications for Aluminum Structures".

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Metal Materials
- B. Metal Fastening

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of other requirements of the Specifications, all work specified herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of the Bid.

- 1. Florida Building Code
- 2. Aluminum Association "Specifications for Aluminum Structures"
- 3. AWS D 1.2 - "Structural Welding Code"

1.04 SUBMITTALS

- A. Submit the following in accordance with the Section entitled "Submittals".
 - 1. Certified Mill Test Reports
 - 2. Affidavit of Compliance with grade specified
 - 3. Shop Drawings which include the following:
 - a. Layout drawings indicating all structural shapes, sizes, and dimensions.
 - b. Beam and column schedules.
 - c. Detailed drawings indicating jointing, anchoring and connection details.

1.05 QUALITY ASSURANCE

- A. Shop inspection may be required by the Owner at its own expense. The Contractor shall give ample notice to the Engineer prior to the beginning of any fabrication work so that inspection may be provided. The Contractor shall furnish all facilities for the inspection of materials and workmanship in the shop and the inspectors shall be allowed free access to the necessary parts of the work. Inspectors shall have the authority to reject any materials or work which do not meet the requirements of these Specifications. Inspection at the shop is intended as a means of facilitating the work and avoiding errors, but is expressly understood that it will in no way relieve the Contractor from its responsibility for furnishing proper materials or workmanship under this Specification.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Structural aluminum shall comply with the Section entitled "Metal Materials".
- B. Fasteners for structural aluminum shall be in accordance with the Section entitled "Metal Fastening". Fasteners shall be Type 316 stainless steel.
- C. Electrodes for welding shall be in accordance with the Section entitled "Metal Fastening".

PART 3 - EXECUTION

3.01 MEASUREMENT

- A. The Contractor shall verify all dimensions and shall make any field measurements necessary and shall be fully responsible for accuracy and layout of work. The Contractor shall review the Drawings and any discrepancies shall be reported to the Engineer for clarification prior to starting fabrication.

3.02 FABRICATION

- A. Fabrication shall be in accordance with the Aluminum Association "Specifications for Aluminum Structures". Fabrication shall begin only after Shop Drawing approval.
- B. Except where otherwise noted on the Drawings or in this Specification, all shop connections shall be welded.
- C. All holes in structural aluminum members required for anchors, anchor bolts, bolt holes, or other members or for attachment of other work shall be provided by the fabricator and detailed on the Shop Drawings.
- D. All materials shall be properly worked and match-marked for field assembly.

3.03 DELIVERY, STORAGE AND HANDLING

- A. Structural members shall be loaded in such a manner that they may be transported and unloaded without being over-stressed, deformed or otherwise damaged.
- B. Structural aluminum members and packaged materials shall be protected from corrosion and deterioration. Material shall be stored in a dry area and shall not be placed in direct contact with the ground. Materials shall not be placed on the structure in a manner that might cause distortion or damage to the members or the supporting structures. The Contractor shall repair or replace damaged materials or structures as directed.

3.04 ERECTION

- A. All temporary bracing, guys and bolts as may be necessary to ensure the safety of the structure until the permanent connections have been made shall be provided by the Contractor.
- B. Structural members shall be set accurately to the lines and elevations indicated. The various members shall be aligned and adjusted to form a part of a complete frame or structure before being permanently fastened. The Contractor shall survey the structural aluminum during erection and shall provide a final survey indicating elevations and locations of all major members. Necessary adjustments to compensate for discrepancies in elevations and alignments shall be performed.

- C. No cutting of structural aluminum members in the field will be allowed except by the written approval of the Engineer.
- D. Bearing surfaces and other surfaces which will be in permanent contact shall be cleaned before assembly.
- E. Field welding shall not be permitted unless specifically indicated in the Drawings or approved in writing by the Engineer. All field welding shall comply with the Section entitled "Metal Fabrication".
- F. All bolted connections shall comply with the Section entitled "Metal Fastening".
- G. All field connections shall be accurately fitted up before being bolted. Drifting shall be only such as will bring the parts into position and shall not be sufficient to enlarge the holes or to distort the metal. All unfair holes shall be drilled or reamed.
- H. Misfits at Bolted Connections
 - 1. Where misfits in erection bolting are encountered, the Engineer shall be immediately notified. The Contractor shall submit a method to remedy the misfit for review by the Engineer. The Engineer will determine whether the remedy is acceptable or if the member must be re-fabricated.
 - 2. Incorrectly sized or misaligned holes in members shall not be enlarged by burning or by the use of drift pins. The Contractor shall notify the Engineer immediately and shall submit a proposed method of remedy for review by the Engineer.
 - 3. Where misalignment between anchor bolts and bolt holes in aluminum members are encountered, the Engineer shall be immediately notified. The Contractor shall submit a method to remedy the misalignment for review by the Engineer.
- I. Grouting of Base Plates and Bearing Plates
 - 1. The bottom surface of the plates shall be cleaned of all foreign materials, and concrete or masonry bearing surface shall be cleaned of all foreign materials and roughened to improve bonding.
 - 2. Accurately set all base and bearing plates to designated levels with steel wedges or leveling plates.
 - 3. Baseplates shall be grouted with non-shrink epoxy grout to assure full uniform bearing. Grouting shall be done prior to placing loads on the structure. Non-shrink epoxy grout shall conform to the Section entitled "Grout".
 - 4. Anchor bolts shall be tightened after the supported members have been positioned and plumbed and the non-shrink grout has attained its specified strength.
- J. Where finishing is required, assembly shall be completed including bolting and welding of units before start of finishing operations.

3.05 FINISHES

- A. Structural aluminum shall be furnished mill finished unless noted otherwise. Anodized finish shall be furnished where noted on the Drawings.

- END OF SECTION -

SECTION 05500 - METAL FABRICATIONS

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, fabricate, and install miscellaneous metalwork and appurtenances, complete, all in accordance with the requirements of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Metal Fastening
- B. Handrails and Railings
- C. Painting

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of other requirements of these Specifications, all work specified herein shall conform to or exceed the requirements of the Florida Building Code and the applicable requirements of the following documents to the extent that the provisions of such documents are not in conflict with the requirements of this Section:
 - 1. American Society for Testing and Materials (ASTM), specifications as referred to herein.
 - 2. American Welding Society (AWS) "Structural Welding Code-Steel" (AWS D1.1) which includes qualification procedures for welders.
 - 3. American Institute of Steel Construction (AISC) "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings" and "Commentary on the AISC Specification."
 - 4. American Iron and Steel Institute (AISI) "Specifications for the Design of Cold-Formed Steel Structural Members" and "Commentary on the AISI Specification."
 - 5. Occupational Safety and Health Administration (OSHA) Regulations.
 - 6. Aluminum Association "Specifications for Aluminum Structures" and "Engineering Data for Aluminum Structures."
 - 7. National Association of Architectural Metal Manufacturers "Metal Stairs Manual."
- B. References herein to "Building Code" shall mean the Florida Building Code.

1.04 SUBMITTALS

- A. Shop drawings of all miscellaneous metalwork shall be submitted to the Engineer for review in accordance with the Section entitled "Submittals".
- B. Safe working load capacity in tension and shear for each size and type of concrete anchor used shall be submitted to the Engineer for review.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Materials are specified in the Section entitled "Metal Materials".
- B. Unless otherwise shown, miscellaneous "steel" metalwork of fabricated steel, which will be used in a corrosive environment and/or will be submerged in water/wastewater shall be coated in accordance with the Section entitled "Painting" and shall not be galvanized prior to coating. Unless otherwise shown, all other miscellaneous steel metalwork shall be hot-dip galvanized after fabrication as specified herein.
- C. Unless otherwise shown, aluminum metalwork shall be of Alloy 6061-T6. Aluminum in contact with concrete, masonry, wood, porous materials, or dissimilar metals shall have contact surfaces coated in accordance with the Section entitled "Painting". Aluminum design shall be in accordance with the Aluminum Association standards. Aluminum shall be fastened with Type 316 stainless steel bolts.
- D. Unless otherwise shown, iron castings shall conform to the requirements of ASTM A48 "Specifications for Gray Iron Castings," Class 30B or better.
- E. Fasteners shall meet all design requirements for intended application. Fasteners not manufactured in the United States shall be tested and certification provided with respect to specified and required quality and strength standards. Certifications of origin shall be submitted for all U.S. fasteners supplied on the project.

2.02 BOLTS AND CONCRETE ANCHORS

- A. Bolts, concrete anchors and other fasteners are specified in the Section entitled "Metal Fastening".

2.03 STEEL PIPE BUMPER GUARDS (BOLLARDS)

- A. Steel pipe bumper guards shall be as detailed on the Drawings, including pipe sleeves, concrete fill, crushed fill and grouting to secure parts. Pipe for guards shall be galvanized steel, Schedule 40 pipe that conforms to ASTM A53. Painting shall be in accordance with the Section entitled Painting.
- B. Steel pipe bumper guards shall be concrete filled and crowned, as detailed on the Drawings.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.
- B. Beginning of installation means erector accepts existing conditions.

3.02 PREPARATION

- A. Clean and strip primed steel items to bare metals where site welding is required.
- B. Supply items required to be cast into concrete with setting templates, to appropriate sections.

3.03 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Field weld components indicated on Drawings.
- D. Obtain Engineer approval prior to site cutting or making adjustments not scheduled.
- E. Fabrication and Erection: Except as otherwise shown, the fabrication and erection of structural steel shall conform to the requirements of the American Institute of Steel Construction "Manual of Steel Construction."

3.04 WELDING

- A. All welding shall be by the metal-arc method or gas-shielded arc method as described in the American Welding Society's "Welding Handbook" as supplemented by other pertinent standards of the AWS. Qualification of welders shall be in accordance with the AWS Standards governing same.
- B. In assembly and during welding, the component parts shall be adequately clamped, supported and restrained to minimize distortion and for control of dimensions. Weld reinforcement shall be as specified by the AWS Code. Upon completion of welding, all weld splatter, flux, slag, and burrs left by attachments shall be removed. Welds shall be repaired to produce a workmanlike appearance, with uniform weld contours and dimensions. All sharp comers of material which is to be painted shall be ground to a minimum of 1/32-inch on the flat.

- END OF SECTION -

SECTION 05510 - METAL STAIRS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish all materials, labor, and equipment required to provide all metal stairs in accordance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Metal Materials
- B. Metal Fastening
- C. Structural Aluminum
- D. Handrails and Railings

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
 - 1. Florida Building Code
 - 2. AISC Specification for Structural Steel Buildings
 - 3. AISI Specification for the Design of Cold-Formed Steel Structural Members
 - 4. Aluminum Association Specifications for Aluminum Structures

1.04 SUBMITTALS

- A. Submit the following in accordance with the Section entitled "Submittals".
 - 1. Complete fabrication and erection drawings of all metal work specified herein.
 - 2. Other submittals as required in accordance with the Sections entitled "Metal Materials" and "Metal Fastening".

PART 2 -- PRODUCTS

2.01 METAL MATERIALS

- A. Metal materials used for metal stairs shall conform to the Section entitled "Metal Materials", unless noted otherwise.

2.02 METAL FASTENING

- A. All welds and fasteners used in metal stairs shall conform to the Section entitled "Metal Fastening", unless noted otherwise.

2.03 METAL STAIRS AND LANDINGS

- A. Stair stringers and structural framing of landings shall be fabricated from aluminum as indicated on the Drawings.
 - 1. Aluminum stairs shall be fabricated from aluminum alloy 6061-T6 in accordance with the Section entitled "Structural Aluminum".
- B. Regardless of material of stringers, all stair treads shall be aluminum.
- C. Where metal landings are required as indicated on the Drawings, gratings at landings shall conform to the Section entitled "Grating, Floor Plates, and Access Hatches".
- D. Handrails for metal stairs shall conform to the Section entitled "Handrails and Railings". Contractor shall coordinate attachment of handrails to metal stairs.
- E. All clips, anchors, and necessary appurtenances shall be provided for a complete and rigid installation.
- F. Closure plates shall be provided for all exposed ends of stringers.
- G. All exposed connections shall be welded and ground smooth, unless otherwise indicated on the Drawings.
- H. Stairs and landings shall be designed to support a 100 psf live load, minimum, unless otherwise indicated on the Drawings.

2.04 STAIR TREADS

- A. Stair treads shall be fabricated of grating sections identical to walkways and landings.
- B. An abrasive nosing shall be provided at the edge of stair tread.
- C. Stair tread shall be fabricated in accordance with the details shown on the Drawings.
- D. Treads shall be attached to stringers with Type 316 stainless steel bolts and nuts. Connection angles shall be of aluminum construction.

PART 3 -- EXECUTION

3.01 FABRICATION

- A. All measurements and dimensions shall be based on field conditions and shall be verified by the Contractor prior to fabrication. Such verification shall include coordination with all adjoining work.
- B. All fabricated work shall be shop fitted together as much as practicable, and delivered to the field, complete and ready for erection. All miscellaneous items such as stiffeners,

fillets, connections, brackets, and other details necessary for a complete installation shall be provided.

- C. All work shall be fabricated and installed in a manner that will provide for expansion and contraction, prevent shearing of bolts, screws, and other fastenings, ensure rigidity, and provide a close fit of sections.
- D. Finished members shall conform to the lines, angles, and curves shown on the drawings and shall be free from distortions of any kind.
- E. All shearings shall be neat and accurate, with parts exposed to view neatly finished. Flame cutting is allowed only when performed utilizing a machine.
- F. All shop connections shall be welded unless otherwise indicated on the Drawings or specified herein. Bolts and welds shall conform to the Section entitled "Metal Fastening". All fastenings shall be concealed where practicable.

3.02 INSTALLATION

- A. Assembly and installation of metal stairs shall be performed in strict accordance with manufacturer's recommendations.
- B. All miscellaneous metalwork shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions.

- END OF SECTION -

SECTION 05520 - HANDRAILS AND RAILINGS

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall make modifications to handrails and railings and appurtenances all in accordance with the requirements of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Metal Fastening
- B. Metal Fabrications
- C. Painting

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work specified herein shall conform to or exceed the requirements of the Florida Building Code, and the applicable requirements of the following documents to the extent that the provisions of such documents are not in conflict with the requirements of this Section. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
 - 1. Florida Building Code
 - 2. Aluminum Association Specifications for Aluminum Structures
 - 3. Occupational Safety and Health Administration (OSHA) Regulations

1.04 SUBMITTALS

- A. Shop drawings of all handrails and railings shall be submitted to the Engineer for review in accordance with the Section entitled "Submittals".

PART 2 - PRODUCTS

2.01 ALUMINUM RAILING SYSTEM

- A. General: Where indicated on the Drawings, aluminum guardrail and handrail shall be provided. In addition, guardrail and handrail shall be supplied as required by the Florida Building Code and OSHA whether indicated on the Drawings or not. Guardrail shall consist of all railings, posts, toe boards, baseplates, anchors, and accessories required for a complete installation.
- B. All metal railing systems shall be fabricated from extruded aluminum alloy 6061-T6 or 6105-T5, with Aluminum Association M12C22A41 clear anodized finish.
- C. Vertical pipe supports shall include cast aluminum base flange or side mount bracket with set screws as indicated on Drawings and as manufactured by Thompson Fabricating, Hollaender Railings, or approved equal. Removable posts shall be sleeved. The joint between upright and sleeve shall be cemented with non-shrink grout.

- D. Wall brackets for handrail shall be of designs indicated on the Drawings and shall be as manufactured by Moultrie Manufacturing Company, J.G. Braun Company, Fulton Metal Products Company, or equal.
- E. All connections between vertical posts and horizontal railing or between sections of horizontal railings shall be shop welded continuous in as long of sections as practical. All welds shall be water tight and ground smooth. Field assembly of welded sections may be made by mechanical fasteners. Location and type of field connections shall be subject to the Engineer's review. Weep holes shall be shop drilled in all vertical posts of external railing.
- F. Design Load: All components of the railings and the railing system shall be adequately designed to resist the design loads of the Florida Building Code. In no case shall the spacing of vertical pipe supports exceed five feet.
- G. Aluminum Guardrails and Handrails: Exterior aluminum pipe railing guardrail posts shall be nominal 1-1/2 inch diameter, Schedule 80 (minimum). Guardrail posts shall be adequately reinforced to meet the code specified design loads. Horizontal top and intermediate railing of the guardrails shall be aluminum pipe railing, nominal 1½-inch diameter, Schedule 40 (minimum). In staircases and other location indicated on the Drawings, horizontal handrailing shall be provided. Such additional railing shall be Schedule 40, 1-inch diameter aluminum pipe, alloy 6060-T6. Horizontal handrails shall be in addition to guardrails provided in open staircases.
- H. Kickplates: Kickplates where not specifically called for in the Drawings shall be furnished and installed typically at the edges of all metal walkways and at other handrail installations. Kickplates shall be ¼-inch thick, must meet OSHA requirements, shall project 4-inches above walkway surface, may not infringe on minimum required walkway width and material must be the same as that of handrail construction. Kickplates shall be connected to handrail posts as detailed on the drawings.
- I. Expansion joint splices shall be provided at 30 feet maximum spacing and at all expansion joints in the structure supporting the handrail. Material for expansion joint splice shall be the same as railing material.
- J. Where safety chains are required in handrails as shown on the Drawings, chains shall be constructed of Type 304 stainless steel. Chains shall be straight link style, 3/16-inch diameter, with at least twelve links per foot, and with snap hooks on each end. Snap 3/4-inch eye diameter welded to the railing posts. Two (2) chains, four inches longer than the anchorage spacing shall be supplied for each guarded area.

2.02 FASTENERS

- A. Type 316 stainless steel fasteners shall be furnished.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. The Contractor shall verify that field conditions are acceptable and are ready to receive work.

- B. Beginning the installation means the Contractor accepts existing conditions.

3.02 PREPARATION

- A. Clean and strip primed items to bare metals where site welding is required.
- B. Supply items required to be cast into concrete with setting templates, to appropriate sections.

3.03 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Provide anchors and plates required for connecting railings to structure.
- C. Aluminum Railings: Aluminum railing fabrication shall be performed by craftsmen experienced in the fabrication of architectural metal work. Exposed surfaces shall be free from defects or other surface blemishes. Dimensions and conditions shall be verified in the field. All joints, junctions, miters and butting sections shall be precision fitted with no gaps occurring between sections, and with all surfaces flush and aligned. Electrolysis protection of materials shall be provided. All dissimilar materials shall be isolated.

3.04 EXPANSION BOLTS

- A. Expansion bolts shall be spaced 10d apart and 5d edge distance (d=diameter of bolt). A safety factor of four shall be provided on expansion bolt pull out values published by the manufacturer.

3.05 ALUMINUM SURFACES

- A. Aluminum surfaces in contact with concrete, grout or dissimilar metals shall be protected with a coat of bitumastic or other approved materials.

- END OF SECTION –

SECTION 09900 - PAINTING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish all labor, tools, materials, supervision and equipment necessary to do all the work specified herein and as required for a complete installation.

1.02 GENERAL INFORMATION AND DESCRIPTION

- A. The term "paint," as used herein, includes emulsions, enamels, paints, stains, varnishes, sealers, cement filler, cement-latex filler and other coatings, whether used as prime, intermediate, or finish coats.
- B. All paint for concrete and metal surfaces shall be especially adapted for use around water treatment plants and shall be applied in conformance with the manufacturer's published specifications and as identified herein.
- C. All paint for final coats shall be fume resistant, compounded with pigments suitable for exposure to gases, especially to hydrogen sulfide and to carbon dioxide. Pigments shall be materials which do not tend to darken, discolor, or fade due to the action of sewage gases. If a paint manufacturer proposes use of paint which is not designated "fume resistant" in its literature, it shall furnish full information concerning the pigments used in this paint.
- D. Coatings used in conjunction with potable water supply systems shall have U.S. Environmental Protection Agency (EPA), National Science Foundation (NSF), and Food and Drug Administration (FDA) approval for use with potable water and shall not impart a taste or odor to the water.
- E. All building, facilities, structures, and appurtenances, as indicated on the Drawings and as specified herein, shall be painted with not less than one shop coat and two field coats, or one prime coat and two finish coats of the appropriate paint. Items to be painted include, but are not limited to exterior and interior concrete, structural steel, miscellaneous metals, steel and aluminum doors and frames, concrete block, ductwork, sluice gates, operators, pipe fittings, valves, mechanical equipment, motors, conduit, and all other work which is obviously required to be painted unless otherwise specified.
- F. Baked-on enamel finishes and items with standard shop finishes such as graphic panels, electrical equipment, toilet partitions, lockers, instrumentation, etc., shall not be field painted unless the finish is damaged during shipment or installation. Aluminum, stainless steel, fiberglass and bronze work shall not be painted unless color coding and marking is required or otherwise specified. A list of surfaces not to be coated is included in Article 1.09 of this Section.
- G. The Contractor shall obtain all permits, licenses and inspections and shall comply with all laws, codes, ordinances, rules and regulations promulgated by authorities having jurisdiction which may bear on the work. This compliance will include Federal Public Law 91-596 more commonly known as the "Occupational Safety and Health Act of 1970".

1.03 MANUFACTURERS

- A. All painting materials shall be as manufactured by Tnemec, Carboline, Ameron, Sherwin Williams, DuPont, or approved equal.

1.04 SUBMITTALS

- A. The Contractor shall submit paint manufacturer's data sheets, application instructions, and samples of each finish and color to the Engineer for review, before any work is started in accordance with the Section entitled, "Submittals."
- B. Submitted samples of each finish and color shall be prepared so that the area of each sample indicates the appearance of the various coats. For example, where a three-coat system is specified, the sample shall be divided into three areas indicating one coat only, two coats and all three coats. The Engineer will provide written authorization constituting a standard, as to color and finish only, for each coating system.
- C. The Contractor shall prepare a complete schedule of surfaces to be coated and shall identify the surface preparation and paint system it proposes to use. The Paint Schedule shall be in conformance with Article 3.03 of this Section. The schedule shall contain the name of the paint manufacturer, and the name, address and telephone number of the manufacturer's representative that will inspect the Work. The schedule shall be submitted to the Engineer for review as soon as possible following the Notice to Proceed so that the schedule may be used to identify colors and to specify shop painting systems on order for fabricated equipment.
- D. Name and detailed qualifications of the protective coatings applicator or subcontractor. Qualifications shall include, but not be limited to, five (5) references which show that the painting applicator or subcontractor has previous successful experience with the specified or comparable coating systems, a list of installations that are currently in service and documentation that applicator or subcontractor is currently a qualified applicator or the proposed coatings by the manufacturer.

1.05 SERVICES OF MANUFACTURER'S REPRESENTATIVE

- A. The Contractor shall purchase paint from an acceptable manufacturer. The manufacturer shall assign a representative to inspect the application of its product both in the shop and field. The Contractor, through the manufacturer's representative, shall submit its report to the Engineer at the completion of its Work identifying the products used and verifying that said products were properly applied and that the paint systems were proper for the exposure and service.
- B. Services shall also include, but not be limited to, inspecting prior coatings of paint, determination of best means of surface preparation, inspection of complete work, and re-inspection of painted work to be performed six months after the job is completed.

1.06 MANUFACTURER'S INSTRUCTIONS

- A. The manufacturer's published instructions for use as a guide in specifying and applying the manufacturers proposed paint shall be submitted to the Engineer. Paint shall not be delivered to the job before acceptance of the manufacturer's instructions is given by the Engineer.
- B. A manufacturer's paint will not be considered for use unless that manufacturer's published instructions meets the following requirements:
 - 1. The instructions must have been written and published by the manufacturer for the purpose and with the intent of giving complete instruction for the use and application of the proposed paint in the locality and for the conditions for which the paint is specified or shown to be applied under this Contract.
 - 2. All limitations, precautions, and requirements that may adversely affect the paint; that may cause unsatisfactory results after the painting application; or that may

cause the paint not to serve the purpose for which it was intended; that is, to protect the covered material from corrosion, shall be clearly and completely stated in the instructions. These limitations and requirements shall, if they exist, include, but not be limited to the following:

- a. Methods of application
 - b. Number of coats
 - c. Thickness of each coat
 - d. Total thickness
 - e. Drying time of each coat, including primer
 - f. Primer required to be used
 - g. Primers not permitted
 - h. Use of a primer
 - i. Thinner and use of thinner
 - j. Temperature and relative humidity limitations during application and after application
 - k. Time allowed between coats
 - l. Protection from sun
 - m. Physical properties of paint including solids content and ingredient analysis
 - n. Surface preparation
 - o. Touch up requirements and limitations
- C. Concrete surfaces specified by the paint manufacturer to be acid etched shall be etched in accordance with the manufacturer's instructions. The surface shall then be thoroughly scrubbed with clean water, rinsed, and allowed to dry. The surface shall be tested with a moisture meter to determine when dry before coating.

1.07 QUALITY ASSURANCE

- A. The Contractor shall give the Engineer a minimum of three days advance notice of the start of any field surface preparation work of coating application work.
- B. All such Work shall be performed only in the presence of the Engineer, unless the Engineer has specifically allowed the performance of such Work in its absence.
- C. Review by the Engineer, or the waiver of review of any particular portion of the work, shall not relieve the Contractor of its responsibility to perform the Work in accordance with these Specifications.
- D. Where coatings are to be performed by a subcontractor, the Contractor shall provide five references which show that the painting subcontractor has previous successful experience with the specified or comparable coating systems. Include the name, address, and the telephone number for the Owner of each installation for which the painting subcontractor provided the protective coating.

1.08 SAFETY AND HEALTH REQUIREMENTS

- A. In accordance with requirements of OSHA Safety and Health Standards for Construction (29CFR1926) and the applicable requirements of regulatory agencies having jurisdiction, as well as manufacturer's printed instructions, appropriate technical bulletins, manuals,

and material safety data sheets, the Contractor shall provide and require use of personnel protective and safety equipment for persons working in or about the project site.

- B. All paints must comply with the requirements of the National Ambient Air Quality Standards.

1.09 SURFACES NOT TO BE COATED

- A. The following items shall not be coated unless otherwise noted:

1. Stainless steel work.
2. Galvanized checkered plate.
3. Aluminum handrails, walkways, windows, louvers, grating and checkered plate.
4. Flexible couplings, lubricated bearing surfaces and insulation.
5. Packing glands and other adjustable parts of mechanical equipment.
6. Finish hardware.
7. Plastic switch plates and receptacle plates.
8. Signs and nameplates.

1.10 QUALITY WORKMANSHIP

- A. The Contractor shall be responsible for the cleanliness of its painting operations and shall use covers and masking tape to protect the work whenever such covering is necessary, or if so requested by the Owner any unwanted paint shall be carefully removed without damage to any finished paint or surface. If damage does occur, the entire surface, adjacent to and including the damaged area, shall be repainted without visible lapmarks and without additional cost to the Owner.
- B. The Contractor shall provide covers made of plywood or other acceptable material to protect Filters in operation while painting work is ongoing in off-line filter.

1.11 ADDITIONAL PAINT

- A. At the end of the project, the Contractor shall turn over to the Owner a gallon can of each type and color of paint, primer, thinner or other coating used in the field painting. If the manufacturer packages the material concerned in gallon cans, then it shall be delivered in unopened labeled cans as it comes from the factory. If the manufacturer does not package the material in gallon cans, and in the case of special colors, the materials shall be delivered in new gallon containers, properly closed with type labels indicating brand, type, color, etc. The manufacturer's literature described the materials and giving directions for their use shall be furnished in three bound copies. A type-written inventory list shall be furnished at the time of delivery.

1.12 SHIPPING, HANDLING AND STORAGE

- A. All painting materials shall be brought to the job site in the original sealed labeled containers of the paint manufacturer and shall be subject to review by the Engineer. Where thinning is necessary, only the product of the manufacturer furnishing the paint shall be used. All such thinning shall be done strictly in accordance with the manufacturer's instructions, and with the full knowledge of the Engineer.
- B. Materials and their storage shall be in full compliance with the requirements of pertinent codes and fire regulations. Receptacles shall be placed outside buildings for paint gates and containers. Paint waste shall not be disposed of in plumbing fixtures, process drains or other plant systems or process units.

PART 2 -- PRODUCTS

2.01 MATERIALS

- A. Table 09900-1 depicts the coatings referenced in Article 3.03 of this Section entitled, "Paint Schedule". Table 09900-1 lists Tnemec products as a reference. Equivalent products by the manufacturers listed in Article 1.03 of this Section may be submitted for review.

TABLE 09900-1
PRODUCT LISTING

<u>Ref. No.</u>	<u>Description</u>	<u>MANUFACTURERS</u> <u>REFERENCE Tnemec</u>
105	Polyamidoamine Epoxy	N69 – Hi Build Epoxoline II
110	Acrylic Polyurethane	1074U Endurashield
115	Aromatic Urethane, Zinc Rich	90-97 Tnemec Zinc
129	Polyamide Epoxy Coal Tar	46H-413 Hi Build Tnemec Tar

2.02 TRAFFIC PAINT

- A. Paint for marking the parking lots shall be Sherwin-Williams PRO-MAR traffic marking paint, or equal. Color shall be white. Paint shall be applied in accordance with the manufacturer's recommendations. Striped areas shall be as indicated on the Plans.

PART 3 – EXECUTION

3.01 SURFACE PREPARATION

- A. Surfaces to be painted shall be clean and dry, and free of dust, rust, scale and all foreign matter. No solvent cleaning, power or hand tool cleaning shall be permitted unless acceptable to the Engineer or specified herein.
- B. Except as otherwise provided, all preparation of metal surfaces shall be in accordance with Specifications SP-1 through SP-10 of the Steel Structures Painting Council (SSPC). Where Steel Structures Painting Specifications are referred to in these Contract Documents, the corresponding Pictorial Surfaces Preparation Standard shall be used to define the minimum final surface conditions to be supplied. Grease and oil shall be removed and the surface prepared by hand tool cleaning, power tool cleaning or blast cleaning in accordance with the appropriate Specification SP-1 through SP-10.
- C. Weld flux, weld spatter and excessive rust scale shall be removed by power tool cleaning as per SSPC-SP-3-63.
- D. Threaded portions of valve and gate stems, machined surfaces which are limited for sliding contact, surfaces which are to be assembled against gaskets, surfaces or shafting on which sprockets are to fit, or which are intended to fit into bearings, machined surfaces of bronze trim on slide gates and similar surfaces shall be masked off to protect them from the blast cleaning of adjacent surfaces. Cadmium-plated or galvanized items shall not be blast cleaned unless hereinafter specified, except that cadmium-plated, zinc-plated, or sherardized fasteners used in assembly of equipment to the blast cleaned shall be blast cleaned in the same manner as the unprotected metal. All installed equipment, mechanical drives, and adjacent painted equipment shall be protected from blast cleaning. Protection

shall prevent any sand or dust from entering the mechanical drive units or equipment where damage could be caused.

- E. Hardware accessories, machined surfaces, plates, lighting fixtures and similar items in place prior to cleaning and painting, and not intended to be painted, shall be protected or removed during painting operations and repositioned upon completion of painting operations.
- F. Any abraded areas of shop or field applied coating shall be touched up with the same type of shop or field applied coating, even to the extent of applying an entire coating, if necessary. Touch-up coating and surface preparations shall be in addition to and not considered as the first field coat.
- G. Sand from sandblasting shall be thoroughly removed, using a vacuum cleaner if necessary. No surface which has been sandblasted shall be painted until inspected by the Engineer.
- H. Exposed Pipe
 - 1. Bituminous coated pipe shall not be used in exposed locations. Pipe which shall be exposed after project completion shall be primed in accordance with the requirements herein. Any bituminous coated ferrous pipe which is inadvertently installed in exposed locations shall be blast cleaned to SSPC-SP-5 White Metal before priming and painting.
 - 2. After installation and prior to finish painting, all exterior, exposed flanged joints shall have the gap between adjoining flanges and gaps between the pipe wall and threaded-on flanges sealed with a single component Thiokol caulking to prevent rust stains.
- I. Ferrous Metal Surfaces
 - 1. All ferrous metal surfaces not required to be galvanized shall be cleaned of all oil grease, dirt, rust and tight and loose mill scale by blasting in accordance with the following: SSPC-SP-5, White Metal Blast Cleaning and comply with the visual standard NACE 1, for shop prepared and shop primed metal to be submerged. SSPC-SP-10 Near White Metal Blast Cleaning, and comply with the visual standard NACE 2 for field prepared metal to be submerged, SSPC-SP6 and comply with the visual standard NACE 3, for field prepared metal in all other locations. Pickling, complying with SSPC-SP-8, may be substituted for Near White Blast in areas as determined by the Engineer. Priming shall follow blast cleaning before any evidence of corrosion occurs, before nightfall and before any moisture is on the surface.
- J. Field surface preparation of small, isolated areas such as field welds, repair of scratches, abrasions or other marks to the shop prime or finish shall be cleaned by power tools in accordance with SSPC-SP-3, or in difficult and otherwise inaccessible areas by hand cleaning in accordance with SSPC-SP-2 and spot primed.
- K. Primed or Coated Surfaces and Non-Ferrous Surfaces
 - 1. All coated surfaces shall be cleaned prior to application of successive coats. All non-ferrous metals not to be coated shall be cleaned. This cleaning shall be done in accordance with SSPC-SP-1, Solvent Cleaning.
- L. Shop Finished Surfaces
 - 1. All shop-coated surfaces shall be protected from damage and corrosion before and after installation by treating damaged areas immediately upon detection. Abraded

or corroded spots on shop-coated surfaces shall be prepared in accordance with SSPC-SP-2, Hand Tool Cleaning and then touched up with the same materials as the shop coat.

2. All shop coated surfaces which are faded, discolored, or which require more than minor touch-up, in the opinion of the Engineer, shall be repainted. Cut edges of galvanized sheets, electrical conduit, and metal pipe sleeves, not to be finish painted, shall be cleaned in accordance with SSPC-SP-1, Solvent Cleaning and primed with zinc dust-zinc oxide metal primer.

M. Galvanized and Copper Alloy Surfaces

1. All copper or galvanized metal surfaces shall be brush blasted and given one coat of epoxy primer.

N. Concrete and Masonry Surfaces

1. Concrete and masonry surfaces to be painted shall be prepared by removing efflorescence, chalk, dust, dirt, grease, oil, form coating, tar and by roughening to remove glaze. All surfaces shall be repaired prior to commencement of the coating operation.
2. Concrete and masonry surfaces are to be cured for at least 28 days prior to coating them.

- O. New concrete immersion surfaces that are to be coated shall be brush blasted per SSPC-SP7 to produce the necessary "sandpaper texture" surface required for satisfactory adherence of the paint. Areas of concrete, which contain blow holes or voids, shall be filled with the manufacturer's approved filler material.

P. Existing Painted Concrete and Masonry Surfaces

1. Existing painted concrete and masonry surfaces requiring paint as identified herein shall be prepared by applying a minimum 3500 psi high pressure water blast to the existing painted surface to remove all loose paint, chalk, dust, dirt, grease, oil, latents, and other foreign materials. Cracks, chips or voids in the existing concrete shall be repaired in accordance with paint manufacturer recommendations.

Q. PVC Pipe Surfaces

1. All pipe surfaces shall be lightly sanded before painting.

3.02 SHOP PAINTING

- A. All fabricated steel work and equipment shall receive at the factory at least one shop coat of prime paint compatible with the paint system required by these Specifications. The Contractor shall coordinate all shop priming to ensure compatibility with paint system specified. Surface preparation prior to shop painting shall be as specified. Finish coats may be applied in the shop if acceptable to the Engineer. All shop painted items shall be properly packaged and stored until they are incorporated in the Work. Any painted surfaces that are damaged during handling, transporting, storage or installation shall be cleaned, scraped, and patched before field painting begins so that Work shall be equal to the original painting received at the shop. Equipment or steel Work that is to be assembled on the site shall likewise receive a minimum of one shop coat of paint at the factory. Surfaces of exposed members that will be inaccessible after erection shall be prepared and painted before erection.
- B. The Contractor shall specify the shop paints to be applied when ordering equipment in order to assure compatibility of shop paints with field paints. The paints and surface

preparation used for shop coating shall be identified on shop drawings submitted to the Engineer for review. Shop paint shop drawings will not be reviewed until the final project paint system has been submitted by the Contractor and reviewed by the Engineer.

- C. Shop finish coats may be the standard finish as ordinarily applied by the manufacturer if it can be demonstrated to the Engineer that the paint system is equal to and compatible with the paint system specified. However, all pumps, motors and other equipment shall receive at least one field applied finish coat after installation.

3.03 PAINT SCHEDULE

- A. The Contractor shall adhere to this paint schedule, providing those paints named or equal. DFT shall mean the minimum dry film thickness per application measured in mils. Products are referenced by numbers listed in Table 09900-1 of this Section entitled "Product Listing." The paint schedule identifies the minimum DFT required per coat. If the Contractor does not achieve the specified DFT range in a single coat, it shall provide additional coats as necessary at no additional cost to the Owner.

B. Metal Surfaces, Atmospheric (Exterior) Exposure

1. Existing and proposed metal surfaces exposed to the atmosphere, and that do not come into contact with wastewater or corrosive atmosphere, including the following types of surfaces shall be painted as described below:
 - a. Pumps, motors, process equipment, machinery, etc.
 - b. Above ground piping, valves, and metal pipe supports
 - c. Miscellaneous steel shapes, angles, etc.
 - d. Exposed non-factory painted surfaces of electric panels, conduit, ventilation fans, air conditioning units, duct work, etc.
 - e. Piping and valves inside below ground, valve vaults.
2. Surface Preparation: Blast clean in accordance with SSPC-SP6
3. Coating System

<u>Application</u>	<u>No.</u>	<u>Description</u>	<u>DFT</u>
First -1 coat	115	Aromatic Urethane Zinc Rich	2.0 - 4.0
Second – 1 coat	105	Polyamidoamine Epoxy	4.0 - 6.0
Finish - 1 coat	110	Acrylic Polyurethane	<u>2.0 - 3.0</u>
Min. Total			10.0 Mils

C. PVC Pipes, Exterior or Interior Exposure

1. PVC pipes, valves, and accessories, shall receive the following types of paint:
2. Surface Preparation: Light sanding
3. Coating System

<u>Application</u>	<u>No.</u>	<u>Description</u>	<u>DFT</u>
First - 1 coat	105	Polyamidoamine Epoxy	2.0 - 3.0
Finish - 1 coat	110	Acrylic Polyurethane	<u>2.0 - 3.0</u>
Min. Total			4.0 Mils

D. New Concrete, Exterior Exposure, Non-water-bearing structures

1. Aboveground concrete surface of pipe supports.
2. Vertical wall of the wellhead structure.

Surface Preparation: SSPC-SP13.

<u>Application</u>	<u>No.</u>	<u>Description</u>	<u>DFT</u>
First - 1 coat		Series 180 Tneme-Crete	4.0 – 8.0
Finish - 1 coat		Series 180 Tneme-Crete	<u>4.0 – 8.0</u>
		Min. Total	12.0 Mils

3.04 PAINTING

- A. All paint shall be applied by experienced painters with brushes or other applicators acceptable to the Engineer.
- B. Paint shall be applied without runs, sags, thin spots, or unacceptable marks. Paints shall be applied at the rate specified by the manufacturer to achieve the minimum dry mil thickness required. Additional coats of paint shall be applied, if necessary, to obtain thickness specified.
- C. Paint shall be applied with spraying equipment only on those surfaces approved by the Engineer. If the material has thickened or must be diluted for application by spray gun, each coat shall be built up to the same film thickness achieved with undiluted brushed-on material. Where thinning is necessary, only the products of the particular manufacturer furnishing the paint shall be used; and all such thinning shall be done in strict accordance with the manufacturer's instructions, as well as with the full knowledge of the Engineer.
- D. Surfaces not accessible to brushes or rollers may be painted by spray by dauber or sheepskins and paint mitt. If any of these methods is to be used, it shall be done in strict accordance with the manufacturer's instructions, as well as with the full knowledge of the Engineer.
- E. Drying Time
 1. A minimum of twenty-four hours drying time shall elapse between applications of any two coats of paint on a particular surface unless shorter time periods are a requirement of the manufacturer or specified herein. Longer drying times shall be required for abnormal conditions as defined by the manufacturer.
- F. Weather Restrictions
 1. No painting whatsoever shall be accomplished in rainy or excessively damp weather when the relative humidity exceeds 85 percent, or when the general air temperature cannot be maintained at 50 degrees Fahrenheit or above throughout the entire drying period. No paint shall be applied when it is expected that the relative humidity will exceed 85 percent or that the air temperature will drop below 50 degrees Fahrenheit within 18 hours after the application of the paint.
 2. Dew or moisture condensation should be anticipated; and if such conditions are prevalent, painting shall be delayed until midmorning to be certain the surfaces are dry. The day's painting shall be completed well in advance of the probable time-of-day when condensation will occur.

G. Inspection of Surfaces

1. Each and every field coat of priming and finishing paint shall be inspected by the Engineer or its authorized representative before the succeeding coat is applied. The Contractor shall follow a system of tinting successive paint coats so that no two coats for a given surface are exactly the same color. Areas to receive black protective coatings shall in such cases be tick marked with white or actually gauged as to thickness when finished.

H. Before application of the prime coat and each succeeding coat, any defects or deficiencies in the prime coat or succeeding coat shall be corrected by the Contractor before application of any subsequent coating.

I. Samples of surface preparation and of painting systems shall be furnished by the Contractor to be used as a standard throughout the job, unless omitted by the Engineer.

J. When any appreciable time has elapsed between coatings, previously coated areas shall be carefully inspected by the Engineer, and where, in its opinion, surfaces are damaged or contaminated, they shall be cleaned and recoated at the Contractor's expense. Recoating times of manufacturer's printed instructions shall be adhered to.

K. Coating thickness shall be determined by the use of a properly calibrated "Nordson-Mikrotest" (or equal) dry mil thickness gauge.

L. The Contractor shall provide free of charge to the Engineer two new "Nordson-Mikrotest" dry film gauges to be used to inspect coating by Engineer and Contractor. One gauge may be used by Contractor and returned each day to the Engineer. Engineer will return gauges to Contractor at completion of job.

M. Special Areas

1. All surfaces which are to be installed against concrete, masonry etc., and will not be accessible for field priming and/or painting shall be back primed and painted as specified herein, before erection. Anchor bolts shall be painted before the erection of equipment and then the accessible surfaces repainted when the equipment is painted.

N. Special attention shall be given to insure that edges, corners, crevices, welds and rivets receive a film thickness equivalent to that of the adjacent painted surfaces.

O. Safety

1. Respirators shall be worn by persons engaged or assisting in spray painting. The Contractor shall provide ventilating equipment and all necessary safety equipment for the protection of the workmen and the Work.

P. Quality Workmanship

1. The Contractor shall be responsible for the cleanliness of its painting operations and shall use covers and masking tape to protect the Work whenever such covering is necessary, or if so requested by the Owner. Any unwanted paint shall be carefully removed without damage to any finished paint or surface. If damage does occur, the entire surface, adjacent to and including the damaged area, shall be repainted without visible lapmarks and without additional cost to the Owner.

Q. Painting found defective shall be scraped or blast cleaned off and repainted as the Engineer may direct. Before final acceptance of the Work, damaged surfaces of paint shall be cleaned and repainted as directed by the Engineer.

- R. Any pipe scheduled to be painted and having received a coating of a tar or asphalt compound shall be painted with two coats of "Intertol Tar Stop", "Tnemec Tar Bar" or equal before successive coats are applied in accordance with the paint schedule.

3.05 SCHEDULE OF COLORS

- A. All colors shall be as designated by the Engineer at the shop drawing review. The Contractor shall submit color samples including custom color choices as required to the Engineer as specified in Article 1.04 of this Section. The Contractor shall submit suitable samples of all colors and finishes for the surfaces to be painted, or on portable surfaces when required by the Engineer. The Engineer shall decide upon the choice of colors and other finishes when alternates exist. No variation shall be made in colors without the acceptance from the Owner. Color names and/or numbers shall be identified according to the appropriate color chart issued by the manufacturer of the particular product in question.

3.06 COLOR CODING AND LETTERING OF PIPING

- A. In general, the pumps and equipment shall be painted the same color as the piping system to which it is connected unless otherwise directed by the Engineer. Where colors are not designated for piping and conduit systems they will be selected during the shop drawing review from the paint manufacturer's standard color charts.
- B. Lettering of Piping: The Contractor shall apply identification titles and arrows indicating the direction of flow of liquids to all types and sections of all new and existing plant piping. Titles shall be as directed by the Engineer. Identification titles shall be located midway between color coding bands where possible. Identification lettering and arrows shall be placed as directed by the Engineer, but shall generally be located each fifteen feet in pipe length and shall be properly inclined to the pipe axis to facilitate easy reading. Titles shall also appear directly adjacent to each side of any wall or slab the pipeline passes through.
- C. The titles shall be painted by use of stencils and shall identify the contents by complete names at least once in each area through which it passes and thereafter be abbreviated. Stencils shall be provided for titles and abbreviations listed in Table 09900-2.
- D. Pipe base color shall be as indicated in Table 09900-2.
- E. Where bands are indicated in Table 09900-2, the pipe is to be painted for its full circumference with a band of the color indicated. The bands shall be six inches wide, neatly made by masking, and spaced eight feet apart. The Contractor may substitute precut prefinished bands on piping subject to acceptance by the Engineer. Where banded pipes are running concurrently in a space, bands shall be located so that on adjacently located pipes, bands will be grouped beside each other.

TABLE 09900-2
PIPE IDENTIFICATION AND COLOR CODING SCHEDULE

PIPE TITLE	ABBREVIATION	BASE COLOR	BAND
RAW WATER	RW	Olive Green	No band

- D. Title color shall be black or white as directed and shall have an overall height in inches in accordance with Table 09900-3. Letter type shall be Helvetica Medium upper case. The manufacturer's instructions shall be followed in respect to storage, surface preparation and application. For piping less than 3/4-inch diameter, the Contractor shall furnish and attach corrosion resistant color tags with the required lettering.

TABLE 09900-3
HEIGHT OF PIPING LETTERING

DIAMETER OF PIPE	HEIGHT OF LETTERING
3/4 to 1-1/4 inches	1/2 inch
1-1/2 to 2 inches	3/4 inch
2-1/2 to 6 inches	1-1/4 inches
8 to 10 inches	2-1/2 inches
Over 10 inches	3-1/2 inches

- F. The Contractor shall paint all piping, valves, equipment, exposed conduits and all appurtenances which are integral to a complete functional mechanical pipe and electrical conduit system. Colors for piping and conduit systems they will be selected during the shop drawing review from the paint manufacturer's standard color charts.

3.07 ANSI AND OSHA SAFETY COLORS

- A. Items specified in the following subsections shall be safety color coated as specified. ANSI colors shall conform to (OSHA) ANSI Z53.1 and latest revisions. Materials shall be compatible with the system specified for the equipment, concrete, etc. Where a coating system is not specified and safety colors are required, the items shall be coated with a primer and two coats Glid-Guard Alkyd Industrial Enamel, or equal.
- B. Red: Items listed in ANSI Z53.1, Section 2.1 shall be painted ANSI Red. In general, these items shall include fire protection equipment and apparatus; wall mounted breathing apparatus, danger signs and locations; and stop bars, buttons or switches. In addition, all hose valves and riser pipes, fire protection piping and sprinkler systems, and electrical stop switches shall be painted ANSI Red.
- C. Orange: Items listed in ANSI Z53.1, Section 2.2 shall be painted ANSI Orange. ANSI Orange shall be used as a basic color for designating dangerous parts of machines or energized equipment which may cut, crush, shock, or otherwise injure and to emphasize such hazards when enclosure doors are open or when gear belt or other guards around moving equipment are open or removed, exposing unguarded hazards. In addition, moving machinery having a linear or peripheral speed in excess of 10 feet per minute, which is either inadequately guarded due to physical problems or may be operated with the guard removed, rims or sprockets, gears, pulleys, etc.; crossheads of large engines and compressors; and flywheels shall be coated ANSI Orange.
- D. Yellow: Items listed in ANSI Z53.1, Section 2.3 shall be painted ANSI Yellow. Yellow shall be the basic color for designating caution and for marking physical hazards such as striking against, stumbling, falling, tripping, and "caught in between". In addition, an 8-inch wide strip on the top and bottom tread of stairways shall be coated.
- E. Green: Items listed in ANSI Z53.1, Section 2.4 shall be painted ANSI Green. Green shall be the basic color for designating safety and the location of first-aid equipment. In general, gas masks, first-aid kits, eye wash facilities, and safety deluge showers shall be coated with ANSI Green.
- F. Blue: Blue shall be used for designating caution, limited to warning against the starting, the use of, or the movement of equipment under repair or being worked upon.
- G. Purple: Items listed in ANSI Z53.1, Section 2.5 shall be painted ANSI Purple. In general, atomic sludge density meters shall be coated ANSI Purple.

3.08 WORK IN CONFINED SPACES

- A. The Contractor shall provide and maintain safe working conditions for all employees. Fresh air shall be supplied continuously to confined spaces through the combined use of

existing openings, forced-draft fans, or by direct air supply to individual workers. Paint fumes shall be exhausted to the outside from the lowest level in the contained space.

- B. Electrical fan motors shall be explosion proof if in contact with fumes. No smoking or open fires will be permitted in, or near, confined spaces where painting is being done.

3.09 CLEANING

- A. The buildings and all other Work area shall be at all times kept free from accumulation of waste material and rubbish caused by the Work. At the completion of the painting, all tools, equipment, scaffolding, surplus materials, and all rubbish around the inside the buildings shall be removed and the Work left broom clean unless otherwise specified.

- END OF SECTION –

SECTION 10525 - SAFETY EQUIPMENT

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. Furnish and install chemical area safety equipment where indicated on the Drawings.

PART 2 -- PRODUCTS

2.01 SAFETY SUNGLASSES

- A. Standard: ANSI Z87.1 High Impact requirements.
- B. Model: Smith and Wesson Equalizer Safety Glasses
- C. Lens Color: Blue Mirror
- D. Frame Style: Half-frame
- E. Frame Design: Wraparound
- F. Grainger Item # 3UXN6
- G. Quantity: 5

PART 3 -- EXECUTION

3.01 DELIVERY

- A. Deliver to water treatment plant Chief Operator.

- END OF SECTION -

SECTION 11000 - EQUIPMENT GENERAL PROVISIONS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, install, test, and place in acceptable operation all mechanical equipment and all necessary accessories as specified herein, as shown on the Drawings, and as required for a complete and operable system.
- B. The mechanical equipment shall be provided complete with all accessories, special tools, spare parts, mountings, and other appurtenances as specified, and as may be required for a complete and operating installation.
- C. It is the intent of these Specifications that the Contractor shall provide the Owner complete and operational equipment/systems. To this end, it is the responsibility of the Contractor to coordinate all interfaces with related mechanical, structural, electrical, instrumentation and control work and to provide necessary ancillary items such as controls, wiring, etc., to make each piece of equipment operational as intended by the Specifications.

1.02 SUBMITTALS

- A. Shop Drawings shall be submitted to the Engineer for all equipment in accordance with Section 01300, Submittals and shall include the following information in addition to the requirements of Section 01300, Submittals:
 - 1. Performance characteristics and descriptive data.
 - 2. Detailed equipment dimensional drawings and setting plans.
 - 3. General lifting, erection, installation, and adjustment instructions, and recommendations.
 - 4. Complete information regarding location, type, size, and length of all field welds in accordance with "Standard Welding Symbols" AWS A2.0 of the American Welding Society. Special conditions shall be fully explained by notes and details.
 - 5. The total uncrated weight of the equipment plus the approximate weight of shipped materials. Support locations and loads that will be transmitted to bases and foundations. Exact size, placement, and embedment requirements of all anchor bolts.
 - 6. Details on materials of construction of all components including applicable ASTM designations.
 - 7. Information on bearing types and bearing life.
 - 8. Gear box design and performance criteria and AGMA service factor.
 - 9. Piping schematics.

10. Motor data sheet indicating motor horsepower; enclosure type; voltage; insulation class; temperature rise and results of dielectric tests; service-rating; rotative speed; motor speed-torque relationship; efficiency and power factor at 1/2, 3/4, and full load; slip at full load; running, full load, and locked rotor current values; and safe running time-current curves.
11. Equipment and motor protective device details. Connection diagrams for motor and all protective devices.
12. Equipment shop coating systems, interior and exterior.
13. Panel layout drawings, schematic wiring diagrams, and component product data sheets for control panels.
14. A list of spare parts and special tools to be provided.
15. Any additional information required to show conformance with the equipment specifications.
16. Warranty documentation including statement of duration of warranty period and contact phone numbers and addresses for warranty issues.

1.03 GENERAL INFORMATION AND DESCRIPTION

- A. All parts of the equipment furnished shall, be designed and constructed for the maximum stresses occurring during fabrication, transportation, installation, testing, and all conditions of operation. All materials shall be new, and both workmanship and materials shall be entirely suitable for the service to which the units are to be subjected and shall conform to all applicable sections of these Specifications.
- B. All parts of duplicate equipment shall be interchangeable without modification. Manufacturer's design shall accommodate all the requirements of these Specifications.
- C. Equipment and appurtenances shall be designed in conformity with ASTM, ASME, AIEE, NEMA, and other generally accepted applicable standards.
- D. All bearings and moving parts shall be adequately protected by bushings or other approved means against wear, and provision shall be made for accessible lubrication by extending lubrication lines and fittings to approximately 30 inches above finished floor elevation.
- E. Details shall be designed for appearance as well as utility. Protruding members, joints, corners, gear covers, etc., shall be finished in appearance. All exposed welds on machinery shall be ground smooth and the corners of structural shapes shall be rounded or chamfered.
- F. Machinery parts shall conform within allowable tolerances to the dimensions shown on the working drawings.
- G. All machinery and equipment shall be safeguarded in accordance with the safety codes of the USA and the State in which the project is located.

- H. All rotating shafts, couplings, or other moving pieces of equipment shall be provided with suitable protective guards of sheet metal or wire mesh, neatly and rigidly supported. Guards shall be removable as required to provide access for repairs.
- I. All equipment greater than 100 pounds shall have lifting lugs, eyebolts, etc., for ease of lifting, without damage or undue stress exerted on its components.
- J. All manufactured items provided under this Section shall be new, of current manufacture, and shall be the products of reputable manufacturers specializing in the manufacture of such products.

1.04 EQUIPMENT WARRANTIES

- A. Warranty requirements may be added to or modified in the individual equipment specifications.
- B. The equipment furnished under this Contract shall be guaranteed to be free from defects in workmanship, design and/or materials for a period of one (1) year unless otherwise specified in the individual equipment specifications. The equipment warranty time period of each group (or type) of equipment shall not commence until the date established for Substantial Completion of the work, or the placement of the equipment in continuous service for its intended use by the OWNER, whichever is later; in accordance with the Contract Documents. If equipment does not perform satisfactorily during the initial thirty days of operation after the start of the warranty period, the balance of the warranty time period for that item shall be placed on hold and the warranty expiration date shall be extended, as necessary, until such time that the equipment has been satisfactorily repaired or replaced, returned to service and has performed satisfactorily for a minimum of 30 days. Upon completion of 30 days of satisfactory service, the warranty period shall resume and the new warranty expiration date shall be established based upon the warranty balance remaining when placed on hold.
- C. The Equipment Supplier shall repair or replace without charge to the Owner any part of equipment which is defective or showing undue wear within the warranty period, or replace the equipment with new equipment if the mechanical performance is unsatisfactory; furnishing all parts, materials, labor, etc., necessary to return the equipment to its specified performance level.
- D. The Contractor shall provide an equipment warranty log book prepared specifically for this project and submit two (2) copies of the document to the Engineer prior to final payment. The equipment warranty log book shall include a summary listing of all equipment warranties provided; date received, and start date and end date of warranty period. A copy of each equipment warranty and equipment start-up certification shall also be provided in the document.
- E. The Equipment Supplier shall guarantee to the Owner that all equipment offered under these specifications, or that any process resulting from the use of such equipment in the manner stated is not the subject of patent litigation, and that he has not knowingly offered equipment, the installation or use of which is likely to result in a patent controversy, in which the Owner as user is likely to be made the defendant.
- F. Where patent infringements are likely to occur, each Equipment Supplier shall submit, as a part of his bid, license arrangements between himself, or the manufacturer, of the

equipment offered, and the patent owner or the controller of the patent, which will permit the use in the specified manner of such mechanical equipment as he may be bidding.

- G. Each Equipment Supplier, by submitting his bid, agrees to hold and save the Owner and Engineer or its officers, agents, servants, and employees harmless from liability of any nature or kind, including cost and expenses for, or on account of, any patented or unpatented invention, process, article, or appliance manufactured or used in the performance of the work under this contract, including the use of the same by the Owner.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. The materials covered by these Specifications are intended to be equipment of proven reliability, and as manufactured by reputable manufacturers having experience in the production of such equipment. The Contractor shall, upon request of the Engineer, furnish the names of not less than 5 successful installations of the manufacturer's equipment of the same size and model of that offered under this contract. The equipment furnished shall be designed, constructed, and installed in accordance with the industry accepted practices and shall operate satisfactorily when installed as shown on the Drawings and operated per manufacturer's recommendations.

2.02 ANCHORS AND SUPPORTS

- A. The Contractor shall furnish, install, and protect all necessary guides, bearing plates, anchor and attachment bolts, and all other appurtenances required for the installation of the devices included in the equipment specified. Working Drawings for installation shall be furnished by the equipment manufacturer, and suitable templates shall be used by the Contractor when required in the detailed equipment Specifications.
- B. Anchor bolts and fasteners shall be furnished in accordance with Section 05050, Metal Fastening, and with the individual equipment Specifications. All anchor bolts shall be a minimum of 1/2-inch diameter. All anchor bolts, handrail bolts, washers, clips, clamps, and fasteners of any type shall be constructed of 316 stainless steel, unless otherwise specified the individual equipment Specifications.
- C. The Contractor shall provide all concrete pads or pedestals required for equipment furnished. All concrete equipment pads shall be a minimum of 6" high, unless otherwise shown on the Drawings and shall be doweled.
- D. Pipe sleeves or other means of adjusting anchor bolts shall be provided where indicated or required. Equipment shall be leveled by first using sitting nuts on the anchor bolts, and then filling the space between the equipment base and concrete pedestal with non-shrink grout, unless alternate methods are recommended by the manufacturer and are acceptable to the Engineer (such as shim leveling pumps, or chemical grout). Non-shrink grout shall be as specified in Section titled "Concrete and Grout".

2.03 STRUCTURAL STEEL

- A. Structural steel used for fabricating equipment shall conform to the requirements of Section 05500, Metal Fabrications.
- B. All materials shall conform to applicable provisions of the AISC Specifications for the design and fabrication of structural steel, and to pertinent ASTM Standard Specifications.

2.04 DISSIMILAR METALS

- A. All dissimilar metals shall be properly isolated to the satisfaction of the Engineer.

2.05 STANDARDIZATION OF GREASE FITTINGS

- A. The grease fittings on all mechanical equipment shall be such that they can be serviced with a single type of grease gun. Fittings shall be "Zerk" type.

2.06 ELECTRICAL REQUIREMENTS

- A. All electrical equipment and appurtenances, including but not limited to motors, panels, conduit and wiring, etc., specified in the equipment specifications shall comply with the applicable requirements of the Division 16 specifications and the latest National Electric Code.
- B. Motors shall conform to the applicable requirements of Division 16.
- C. In the individual equipment specifications, specified motor horsepower is intended to be the minimum size motor to be provided. If a larger motor is required to meet the specified operating conditions and performance requirements, the Contractor shall furnish the larger sized motor and shall upgrade the electrical service (conduit, wires, starters, etc.) at no additional cost to the Owner.
- D. Where variable frequency drives (VFDs) are specified, the Contractor shall be responsible for coordinating between equipment supplier and VFD supplier to ensure a complete and operational system. VFDs shall be furnished under Division 16.
- E. Motor starters and controls shall be furnished and installed under Division 16 and Division 17 unless otherwise specified in the individual pump specifications.

2.07 ACCESSORIES, SPARE PARTS, AND SPECIAL TOOLS

- A. Spare parts for equipment shall be furnished where indicated in the equipment Specifications or where recommended by the equipment manufacturer.
- B. Spare parts shall be identical and interchangeable with original parts.
- C. The spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.
- D. Painting requirements for spare parts shall be identical to those for original, installed parts. Where no painting or protective coating is specified, suitable provisions shall be made to protect against corrosion.

- E. Spare parts shall be delivered at the same time as the equipment to which they pertain. Spare parts shall be stored separately in a locked area, maintained by the Contractor, and shall be turned over to the Owner in a group prior to substantial completion. All of these materials shall be properly packed, labeled, and stored where directed by the Owner and Engineer.
- F. The Contractor shall furnish all special tools necessary to operate, disassemble, service, repair, and adjust the equipment in accordance with the manufacturers operation and maintenance manual.
- G. The Contractor shall furnish a one year supply of all recommended lubricating oils and greases. The manufacturer shall submit a list of at least four manufacturer's standard lubricants which may be used interchangeably for each type of lubricant required. All of these materials shall be properly packed, labeled and stored where directed by the Engineer.

2.08 EQUIPMENT IDENTIFICATION

- A. All equipment shall be provided with a substantial stainless steel nameplate, mechanically fastened with stainless steel hardware in a conspicuous place, and clearly inscribed with the manufacturer's name, year of manufacture, serial number, and principal rating data.
- B. All equipment provided under Divisions 11 through 15 including motorized and manual valves shall also be identified as to the equipment name and equipment tag number by a suitable laminated plastic or stainless steel nameplate mechanically fastened with stainless steel hardware. Equipment names and equipment tag numbers shall match the names provided for the equipment as identified on the Drawings and in the Specifications. Equipment names and tag numbers not currently identified in the Drawings and Specifications shall be provided to the Contractor prior to the fabrication of the nameplates. Coordinate name and number with same on remotely located controls, control panel, and other related equipment. For buried valve applications, the valve name and number shall be included in the bronze disc embedded in the valve's concrete collar as identified on the Drawings.
- C. Nameplates shall not be painted over.

PART 3 -- EXECUTION

3.01 SHOP TESTING

- A. Not Used.

3.02 STORAGE OF EQUIPMENT AND MATERIALS

- A. Contractor shall store his equipment and materials at the job site in strict accordance with the manufacturer's recommendations and as directed by the Owner or Engineer, and in conformity to applicable statutes, ordinances, regulations, and rulings of the public authority having jurisdiction. Equipment and materials shall not be delivered to the site prior to 90 days in advance of the scheduled installation. Partial payment requests will not be processed for materials delivered prior to 90 days before installation or for materials that are not properly stored.

- B. Material or equipment stored on the job site is stored at the Contractor's risk. Any damage sustained of whatever nature shall be repaired to the Engineer's satisfaction at no expense to the Owner. Stored electrical equipment is to be protected from the elements and shall have space heaters energized.
- C. Contractor shall not store unnecessary materials or equipment on the job site and shall take care to prevent any structure from being loaded with a weight which will endanger its security or the safety of persons.
- D. Contractor shall observe all regulatory signs for loadings on structures, fire safety, and smoking areas.
- E. Contractor shall not store materials or encroach upon private property without the written consent of the owners of such private property.

3.03 MANUFACTURER'S FIELD SERVICES

- A. The Contractor shall arrange for a qualified Technical Representative from each manufacturer or supplier of equipment who is regularly involved in the inspection, installation, start-up, troubleshooting, testing, maintenance, and operation of the specified equipment. Qualification of the Technical Representative shall be appropriate to the type of equipment furnished and subject to the approval of the Engineer and the Owner. Where equipment furnished has significant process complexity, furnish the services of engineering personnel knowledgeable in the process involved and the function of the equipment. When necessary, the Contractor shall schedule multiple Technical Representatives to be present at the same time for the purpose of coordinating the operation of multiple pieces of related equipment.
- B. For each site visit, the Technical Representative shall submit jointly to the Owner, the Engineer, and the Contractor a complete signed report of the results of his inspection, operation, adjustments, and testing. The report shall include detailed descriptions of the points inspected, tests and adjustments made, quantitative results obtained if such are specified.
- C. The manufacturer's Technical Representative shall provide the following services.
 - 1. Installation: The Technical Representative shall inspect the installed equipment to verify that installation is in accordance with the manufacturer's requirements. Where required by individual equipment specifications, the Technical Representative shall also supervise the installation of the equipment.
 - 2. Testing: After installation of the equipment has been completed and the equipment is presumably ready for operation, but before it is operated by others, the Technical Representative shall inspect, operate, test, and adjust the equipment as required to prove that the equipment is in proper condition for satisfactory operation under the conditions specified. Unless otherwise noted in the signed site visit report, the report shall constitute a certification that the equipment conforms to the requirements of the Contract and is ready for startup and that nothing in the installation will render the manufacturer's warranty null and void. The report shall include date of final acceptance field test, as well as a listing of all persons present during tests.

3. Startup: The Technical Representative shall start up the equipment for actual service with the help of the Contractor. In the event that equipment or installation problems are experienced, the Contractor and the representative shall provide the necessary services until the equipment is operating satisfactorily and performing according to the specifications at no additional cost to the Owner. Unless otherwise noted in the signed site visit report, the report shall constitute a certification that the equipment conforms to the requirements of the Contract and is ready for permanent operation and that nothing in the installation will render the manufacturer's warranty null and void.
 4. Training: The Technical Representative shall instruct the Owner's operating personnel in correct operation and maintenance procedures. The instruction shall demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment. Such instruction shall be scheduled at a time arranged with the Owner at least 2 weeks in advance of the training and shall be provided while the respective Technical Representative's equipment is fully operational. The Contractor shall have submitted, and had accepted, the O&M Manuals prior to commencement of training. Training shall be provided to three separate shifts of the Owner's personnel between the hours of 8:00 A.M. and 6:00 P.M. as necessary. The Contractor shall provide professional video recording of all training sessions. Completed, labeled recordings shall be provided to the Owner for each type of training session.
 5. Services after Startup: Where required by the individual equipment specifications, the Technical Representative shall return to the project site thirty (30) days after the start up date to review the equipment performance, correct any equipment problems, and conduct operation and maintenance classes as required by the Owner. This follow-up trip is required in addition to the specified services of Technical Representative prior to and during equipment startup. At this time, if there are no equipment problems, each manufacturer shall certify to the Owner in writing that his equipment is fully operational and capable of meeting operating requirements. If the equipment is operating incorrectly, the Technical Representative will make no certification to the Owner until the problems are corrected and the equipment demonstrates a successful thirty (30) days operating period.
- D. Services of the Technical Representative will require a minimum of two (2) site visits, one for installation and testing and one for startup and training, and will be for the minimum number of days recommended by the manufacturer and approved by the Engineer but will not be less than the number of days specified in individual equipment sections.
 - E. The Contract amount shall include the cost of furnishing the Technical Representative for the minimum number of days specified, and any additional time required to achieve successful installation and operation. The times specified for services by the Technical Representative in the equipment Specifications are exclusive of travel time to and from the facility and shall not be construed as to relieve the manufacturer of any additional visits to provide sufficient service to place the equipment in satisfactory operation.
 - F. The Contractor shall notify the Engineer at least 14 days in advance of each equipment test or Owner training session.

- G. The Technical Representative shall sign in and out at the office of the Engineer's Resident Project Representative on each day he is at the project.

3.04 INSTALLATION

- A. The Contractor shall obtain written installation manuals from the equipment manufacturer prior to installation. Equipment shall be installed strictly in accordance with recommendations of the manufacturer. A copy of all installation instructions shall be furnished the Engineer's field representative one week prior to installation.
- B. The Contractor shall have on hand sufficient personnel, proper construction equipment, and machinery of ample capacity to facilitate the work and to handle all emergencies normally encountered in work of this character. To minimize field erection problems, mechanical units shall be factory-assembled insofar as practical.
- C. Equipment shall be erected in a neat and workmanlike manner on the foundations at the locations and elevations shown on the Drawings.
- D. All equipment sections and loose items shall be match-marked prior to shipping.
- E. For equipment such as pumping units, which require field alignment and connections, the Contractor shall provide the services of the manufacturer's qualified mechanic, millwright, or machinist, to align the pump and motor prior to making piping connections or anchoring the pump base. Alignment shall be as specified herein.
- F. The Contractor shall furnish oil and grease for initial operation and testing. The manufacturer and grades of oil and grease shall be in accordance with the recommendations of the equipment manufacturer.

3.05 ALIGNMENT

- A. Set equipment to dimensions shown on drawings. Dimensions shall be accurate to +/- 1/16 inch unless otherwise noted on the drawings. Wedges shall not be used for leveling, aligning, or supporting equipment.
- B. General Equipment Leveling: Non-rotating equipment shall be set level to +/- 1/16 inch per 10 foot length (.005 inch per foot) unless otherwise noted on the drawings. Shims shall be used unless equipment is furnished with leveling feet. Set shims flush with equipment baseplate edges. When grouting is required, equipment shall be shimmed to allow a minimum of one inch grout thickness. Grout shall cover shims at least 3 inches. Final level check shall be held for inspection and approval by Engineer before proceeding.
- C. Grouting
 - 1. Fill anchor bolt holes or sleeves with grout, after bolt alignment is proven, and prior to placing grout under equipment bases.
 - 2. Surface Preparation. Roughen surface by chipping, removing laitance, and unsound concrete. Clean area of all foreign material such as oil, grease, and scale. Saturate area with water at least 4 hours prior to grouting, removing excess water ponds.

3. Application. Place grout after the equipment base has been set and its alignment and level have been approved. Form around the base, mix grout, and place in accordance with the grout manufacturers published instructions. Eliminate all air or water pockets beneath the base using a drag chain or rope.
 4. Finishing. Point the edges of the grout to form a smooth 45 degree slope.
 5. After grout has cured (not before 3 days after placement) paint exposed surfaces of grout with shellac.
 6. Level Verification. After grout has cured, and immediately prior to drive alignment, recheck equipment for level and plumb. Re-level and square as necessary. Hold final checks for inspection and approval by Engineer.
- D. Inspect for and remove all machining burrs or thread pulls in female holes on mating surfaces of mounting frame and machine feet.
- E. Inspect and clean equipment mounting base pads, feet, and frames to remove all grease, rust, paint and dirt.
- F. Assembled equipment shafts shall be set level to .0015 inches per foot of shaft length (+/- 0005 inches) up to a maximum of 0.015 inches for any length shaft unless the manufacturers requirements are more stringent or unless otherwise noted in the equipment specifications. Use the machined surfaces on which the equipment sets for the base/mounting frame leveling plane. Use the machined shaft surface for equipment leveling plane.
- G. Sprocket and Sheave Alignment. Check shaft mounted components for face runout and eccentricity (outside diameter) runout by magnetically mounting a dial indicator on a stationary base and indicating over 360 degrees on a continuous machined surface at the outside diameter of the component. Maximum allowable total indicated face runout and eccentricity for sprockets and sheaves will be per ANSI Standard B29.1-1975.
- H. Belt tensioning. Set drive belt tension to manufacturer's specification for the belt type. Recheck alignment after drive tensioning.
- I. Thermal/Mechanical Growth. Thermal/mechanical growth corrections for driver and driven machines will be used in vertical and horizontal alignment where applicable. The equipment manufacturer will determine thermal/mechanical growth applicability for any machine and provide the correction offsets to be used.
- J. Rotating Shaft Alignment
1. Fixtures will be set up on the driver and driven machine, machines shaft surfaces. Machined coupling hubs may be used only if there is no clearance to mount fixtures directly on the shafts.
 2. Primary alignment method for direct drive machines is when coupled. Uncoupled alignment will be used only when approved by the Engineer.
 3. Account for possible coupling flex by always rotating coupled machines in the same direction during alignment.

4. Uncoupled machines must be connected so that both shafts turn together without relative motion during alignment.
5. Indicator bar sag will be measured and included for each reverse indicator alignment setup.
6. Reverse Dial Indicator. The final maximum allowable misalignment: vertical and horizontal from the desired targets of .000 inches (for a non-thermal growth machine) or from the given target readings (for a thermal growth machine) must meet BOTH of the following conditions simultaneously: 1/2 the final total indicator reading at each indicator will be no more than shown in the table below AND the final remaining correction at each machine foot be no more than .001 inches of required movement.

<i>Machine Speed (RPM)</i>	<i>Total Misalignment* (inches)</i>
Up to 1800	.002
1800 and greater	.001

* 1/2 indicator reading

3.06 FIELD TESTING

- A. See Section titled "Equipment Testing and Startup".

3.07 VIBRATION TESTING

- A. Not used.

3.08 FAILURE OF EQUIPMENT TO PERFORM

- A. Any defects in the equipment, or failure to meet the guarantees or performance requirements of the Specifications, shall be promptly corrected by the Contractor by replacements or otherwise.
- B. If the Contractor fails to make these corrections, or if the improved equipment shall fail again to meet the guarantees or specified requirements, the Owner, notwithstanding his having made partial payment for work and materials which have entered into the manufacture of said equipment, may reject said equipment and order the Contractor to remove it from the premises at the Contractor's expense.
- C. The Contractor shall then obtain specified equipment to meet the contract requirements or upon mutual agreement with the Owner, adjust the contract price to reflect not supplying the specific equipment item.
- D. In case the Owner rejects said equipment, then the Contractor hereby agrees to repay to the Owner all sums of money paid to him for said rejected equipment on progress certificates or otherwise on account of the lump sum prices herein specified.
- E. Upon receipt of said sums of money, the Owner will execute and deliver to the Contractor a bill of sale of all his rights, title, and interest in and to said rejected equipment; provided,

however, that said equipment shall not be removed from the premises until the Owner obtains from other sources other equipment to take the place of that rejected.

- F. Said bill of sale shall not abrogate Owner's right to recover damages for delays, losses, or other conditions arising out of the basic contract.

3.09 PAINTING

- A. All surface preparation, shop painting, field repairs, finish painting, and other pertinent detailed painting specifications shall conform to applicable sections of Section 09900 - Painting.
- B. All shop coatings shall be compatible with proposed field coatings.
- C. All inaccessible surfaces of the equipment, which normally require painting, shall be finished painted by the manufacturer. The equipment and motor shall be painted with a high quality epoxy polyamide semi-gloss coating specifically resistant to chemical, solvent, moisture, and acid environmental conditions, unless otherwise specified.
- D. Gears, bearing surfaces, and other unpainted surfaces shall be protected prior to shipment by a heavy covering of rust-preventive compound sprayed or hand applied which shall be maintained until the equipment is placed in operation. This coating shall be easily removable by a solvent.

3.10 WELDING

- A. The Equipment Manufacturer's shop welding procedures, welders, and welding operators shall be qualified and certified in accordance with the requirement of AWS D1.1 "Structural Welding Code - Steel" or AWS D1.2 "Structural Welding Code - Aluminum" of the American Welding Society, as applicable.
- B. The Contractor's welding procedures, welders, and welding operators shall be qualified and certified in accordance with the requirements of AWS D1.1 "Structural Welding Code - Steel" or AWS D1.2 "Structural Welding Code - Aluminum" of the American Welding Society, as applicable.
- C. The Contractor shall perform all field welding in conformance with the information shown on the Equipment Manufacturer's drawings regarding location, type, size, and length of all welds in accordance with "Standard Welding Symbols" AWS A2.0 of the American Welding Society, and special conditions, as shown by notes and details.

- END OF SECTION -

SECTION 11155 – SUBMERSIBLE WELL PUMPS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Furnish, paint, factory test, deliver ready for installation, provide assistance during installation and field testing, and make fully operational all pumping equipment, complete with all necessary accessories, in compliance with the Contract Documents.
- B. The CONTRACTOR through the pump manufacturer shall have unit responsibility for supplying each of the pump units under this specification inclusive of the following components:
 - 1. submersible turbine pump;
 - 2. intake screen;
 - 3. check valve;
 - 4. submersible pump motor;
 - 5. motor shroud
 - 6. wellhead discharge elbow and surface plate;
 - 7. water-tight cable glands;
 - 8. submersible power cable;
 - 9. pump discharge column pipe;
 - 10. pump safety cables;
 - 11. pump local control panel; and
 - 12. All other appurtenances and accessories required for a complete installation of the system.
- C. All necessary accessory equipment and appurtenances shall be provided for a complete and operating system whether or not defined in the Specifications or shown on the Drawings. This equipment shall incorporate the highest standards for the type of service described herein, including field testing of the installations and instruction of the regular operating personnel in the care, operation, and maintenance of all equipment.

1.03 SUBMITTALS

- A. Shop Drawings: The CONTRACTOR shall submit Shop Drawings in accordance with the following requirements:
 - 1. All dimensions shall be shown in English units.
 - 2. The Shop Drawings shall include the following:
 - a. Include specifications, technical data, and drawings of the equipment materials proposed to be furnished, showing the dimensions of the principal parts, the general arrangement and assembly, the method of field assembly and erection, method of dismantling, method of removing and replacing the principal parts, the

materials of which the principal parts are to be made, wiring diagrams of sufficient detail to allow proper control and power wiring to the equipment. Materials shall be identified with corresponding code or serial numbers referring to standards of the American Society for Testing and Materials, or to other recognized standards.

- b. Catalog information including cross section of pumps, motors, and pump discharge column.
 - c. Pump performance curves for total head and flow, bowl efficiencies, required net positive suction head (NPSH), and brake horsepower curves at pump rotative speeds corresponding to the conditions specified.
 - d. Pump performance curves shall be corrected for derating for the pump bowl material, impeller material and any other applicable derating factors. Pump performance curves shall clearly indicate all derating factors. Pump performance curves based on manufacturer's standard materials will be rejected.
 - e. Pump motor efficiency, power factor, full load current, service factor and cooling water velocity requirement over the range of conditions specified.
 - f. Overall wire to water efficiency for the pumps (pump efficiency times motor efficiency)
 - g. Instructions for field procedures for erection, adjustments, inspection, and testing shall be provided with the Shop Drawings.
 - h. Recommended spare parts list.
 - i. Recommendations for short-term storage.
 - j. Recommendations for long-term storage.
 - k. Two copies of a preliminary O&M manual shall be included in the Shop Drawing submittal. Without inclusion of these manuals, the submittal will be considered incomplete and will be returned unreviewed.
- B. Factory Certified Performance Curves: After fabrication and prior to shipment to the jobsite, the CONTRACTOR shall submit to the ENGINEER factory certified pump performance curves for each pump. Pumps shall be equipped with the job motors.
- C. O & M Manuals: The CONTRACTOR shall provide digital operation and maintenance (O&M) manuals. O&M manuals shall be searchable. O&M Manuals shall contain the following information on the following items as a minimum: Operating Instructions, Troubleshooting, Maintenance Schedule, Lubricants, Location of Service Center, Parts List, Spare Parts List, Special Tools List, Installation Instructions, Assembly & Erection Drawings, Dimensional Drawings, Wiring Diagram(s), and Storage Instructions.
- D. Field Test Documentation: Submit field test documentation required by the Section titled "Equipment Startup and Testing".

- E. Starter Settings Inspection Report: The pump manufacturer's service representative shall document in writing that it has inspected the starter starting and stopping settings and that the settings comply with the motor manufacturer's published guidelines.

1.04 CONTRACTOR'S RESPONSIBILITY

- A. CONTRACTOR shall have unit responsibility for coordination of all equipment, including motors, controls, and services required for proper installation and operation of the completely assembled and installed pumps.
- B. The CONTRACTOR shall provide the services of a qualified manufacturer's technical representative from the pump manufacturer with at least five (5) years of experience and regularly involved in the inspection, installation, start-up, troubleshooting, testing, maintenance, and operation of well pumps, who shall adequately supervise the installation and testing of all equipment furnished under this Contract and instruct the OWNER's operating personnel in its maintenance and operation. The manufacturer's technical representative shall:
 - 1. Witness and check installation of pumps and motors.
 - 2. Assist the CONTRACTOR in conducting field tests.
 - 3. Witness and check start-up of the system.
 - 4. Assist the CONTRACTOR in making adjustments and modifications as necessary to optimize performance and to minimize vibration and wear.
 - 5. Troubleshoot and assist the CONTRACTOR in correcting any mechanical or control problems encountered during tests and start-up.
 - 6. Submit written certification that the equipment has been properly installed, tested, and adjusted; that the system operates as specified or as required; and that all controls and protective devices operate properly, including date of final acceptance test, as well as a listing of all persons present during the tests.
 - 7. Investigate and supervise correction of any operating problems that may arise up to the end of the guarantee period of the equipment.
 - 8. Instruct OWNER's personnel in the operation and maintenance of equipment.
- B. The manufacturer's technical representative shall supervise and check the installation, supervise its initial operation, and instruct the OWNER in operation, proper maintenance and repairs, for not less than one (1) day.
- C. Any additional time required to achieve successful installation and operation shall be at the expense of the CONTRACTOR.
- D. The report covering the manufacturer's technical representative's findings and installation approval shall cover all inspection and outline in detail any deficiencies noted.

- E. The times specified are exclusive of travel time to and from the facility and shall not be construed as to relieve the CONTRACTOR of any additional visits to provide sufficient service to place the equipment in satisfactory operation.

1.05 WARRANTY

- A. The CONTRACTOR shall guarantee the pumps and motors for a period of 12-months from date of install or 18-months from date of shipment, whichever occurs first.

1.06 DELIVERY, STORAGE AND HANDLING

- A. CONTRACTOR shall give OWNER and ENGINEER at least seven (7) days prior written notice of the date when the equipment will be ready for shipment and the manner of shipment.
- B. Special care in handling shall be exercised during loading, delivery, and unloading of equipment. Damaged equipment will be rejected and shall be replaced at the CONTRACTOR's expense.
- C. All equipment shall be stored in accordance with the manufacturer's recommendations.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

- A. The materials covered by these Specifications are intended to be standard equipment of proven reliability and as manufactured by reputable manufacturers having experience in the production of such equipment. The equipment furnished shall be designed, constructed, and installed in accordance with the best practices and methods and shall operate satisfactorily when installed as shown on the Drawings and operated per manufacturer's recommendations.
- B. The submersible well pump shall be Xylem Goulds Water Technology Model 14RHMC 4-stage with 9.125-inch impeller trim, or Equal.
- C. The submersible motor shall be selected by the pump manufacturer.

2.02 PUMP CONSTRUCTION

- A. Pump Bowls: Pump bowls shall be nickel aluminum bronze, ASTM B148, Alloy C95800. Castings shall be free from blow holes, sand holes, and all other defects and shall be accurately machined and fitted to close dimensions. All bolts used in bowl assembly shall meet the requirements of ASTM A193, Grade B8M.
- B. Suction and Discharge Cases: Each pump bowl assembly shall have a motor adaptor and a female threaded discharge case of nickel aluminum bronze, ASTM B148, Alloy C95800. The discharge case shall incorporate a factory set shaft upthrust plug.
- C. Impellers: Impellers shall be of the enclosed type as required to meet the specified performance requirements and shall be accurately machined and dynamically balanced. The impellers shall be secured to the shaft with Type 316 stainless steel tapered lock

bushing. Impellers shall be nickel aluminum bronze, ASTM B148, Alloy C95800.

- D. Bowl Shaft: The pump shall have a Type 316 stainless steel shaft.
- E. Wear Rings: Impeller wear rings shall be nickel aluminum bronze, ASTM B148, Alloy C95800. Bowl wear rings shall be Type 316 stainless steel. Bowl wear rings shall have a Brinell hardness of 50 units greater than that of the impeller wear rings.
- F. Bearings: Pump shall be furnished with bowl, discharge case and motor adaptor housing bearings. Pump shall be provided with fluted rubber bearings. All bearings shall be water lubricated. The motor adaptor housing bearing shall be equipped with a sand collar to exclude sand from the bearing.

2.03 PUMP DISCHARGE COLUMN

- A. Material: Type 316L stainless steel schedule 10S pipe.
- B. Joints: class 150 type 316L stainless steel flanges.
- C. Flange Notches: The perimeter of flanges shall be notched to accept the electrical cables and level sensor cable and the cables secured to the flanges with 316 stainless steel bands.
- D. Pump Discharge Column Length: 60-feet total length in 20-foot sections.
- E. Bolts: Pump discharge column pipe flange bolts shall meet the requirements of ASTM A193, Grade B8M.
- F. Flange Gaskets: as recommended by the pump supplier.

2.04 THREADED BY FLANGED-END ADAPTOR NIPPLES

- A. Schedule 40S Type 316L stainless steel threaded by flanged end adaptor nipples shall be provided as follows:
 - 1. Between the threaded riser check valve and the flanged pump discharge column pipe.
 - 2. From the threaded pump discharge case.
 - 3. From the threaded riser check valve and the flanged end of the pump discharge adapter nipple.

2.05 WELLHEAD DISCHARGE ELBOW AND SURFACE PLATE

- A. Surface plate shall be fabricated from Type 316L stainless steel with a flat base flange to match the wellhead spool and a Type 316L stainless steel discharge elbow terminating in a flat-faced, class 150 Type 316L stainless steel flange.
- B. A 12-inch long Type 316L stainless steel flanged nipple shall extend below the surface plate for connections to the pump discharge column pipe.
- C. Discharge Elbow Diameter: See Drawings.
- D. The plate shall be furnished with lifting lugs to support the complete weight of pump discharge column pipe, pump and motor.

- E. The surface-plate shall be provided with penetrations for electrical and instrumentation cables as follows:
 - 1. 1.5-inch vent pipe connection
 - 2. 2-inch spare (with plug)
 - 3. 4-inch motor power cable
 - 4. 4-inch spare (with plug)
 - 5. 1.25-inch water level sensor cable
 - 6. All other penetrations necessary for a complete and operable facility
- F. Additional Requirements: Comply with the requirements on the Drawings for the wellhead discharge detail.

2.06 PUMP SAFETY CABLES

- A. Provide two pump safety cables. Each cable shall be capable of supporting the entire weight of the pump and its appurtenances.
- B. The cables shall be anchored to prevent the pump from falling down the well in the event of a drop pipe failure.
- C. The cables shall be 316 stainless steel.

2.07 PUMP APPURTENANCES

- A. Cable Glands: The surface plate shall be provided with watertight cable glands to seal cable penetrations. The glands shall be as manufactured by O.Z. Gedney or equal.
- B. Riser Check Valves: The pump(s) shall be equipped with a check valve fitted to the pump discharge casing. The valve shall be double leaf type and designed specifically for submerged, deep well service. Provide break away plug to release water in pump discharge column pipe when removing pump from the well. Riser check valves shall comply with the following:
 - a. Valve body material: 316 stainless steel
 - b. Internals material: 316 stainless steel
 - c. Spring material: 316 stainless steel
 - d. Sealing Elastomers: Buna-N.
 - e. Working pressure: 300 psi
 - f. Manufacturers:
 - i. Techno Style 5002F-316
 - ii. or equal.

- C. Nameplates: Each pump shall be equipped with a 316 stainless-steel nameplate indicating rated head in feet, flow in gpm, efficiency at design point, pump speed, pump size and type, impeller size, motor horsepower, and manufacturer's name, model and serial number. Nameplate shall be affixed to the surface plate.
- D. Suction Strainer and Cable Guard: Each pump shall be furnished with a 316 stainless-steel suction strainer fitted to the motor adaptor housing and a stainless-steel cable protector to protect the submersible cable where it passes alongside the pump. The stainless-steel thickness must be equivalent to 14 gauge or thicker.
- E. Flow Shroud: Pump manufacturer shall provide a flow shroud to direct flow past the motor if required cooling water velocity to meet a service factor of 1.15 exceeds 0.5-fps. Shroud shall be fabricated of schedule 80 PVC and be securely attached to pump and motor. Flow shroud design shall be based on the following:
- | | |
|-------------------------|---|
| 1. Well Casing | 24-inch nominal diameter schedule 80 PVC |
| 2. Well Inside Diameter | 21.4-inches |
| 3. Minimum Pump Flow | 1,850-gpm |
| 4. Water Flow Direction | Assume all water comes from below the motor |

2.08 PUMP OPERATING CONDITIONS AND CHARACTERISTICS

- A. Pump operating conditions and characteristics shall be as follows:

- | | | |
|----|--|-----------|
| 1. | Design Basis: As indicated in Article 2.01 | |
| 2. | Design Point: | |
| | Flow | 2,200-gpm |
| | Total Dynamic Head | 235-ft |
| | Minimum bowl efficiency | 79% |
| 3. | Run-out Operating Point: | |
| | Flow | 2,750-gpm |
| | Total Dynamic Head | 160-ft |
| | Minimum bowl efficiency | 71% |
| 4. | Pump Shut-Off Head | 392-feet |
| 5. | Nominal Pump Operating Speed | 1,800 rpm |
| 6. | NPSH Available at runout: | 60-feet |

2.09 SUBMERSIBLE MOTOR

- A. The submersible electric motor shall be water filled squirrel cage induction motors. Motors shall comply with the following:
- | | |
|------------------------------|---|
| 1. Motor Horsepower | 200-hp |
| 2. Drive | Constant Speed |
| 3. Speed | 1800 rpm (constant) |
| 4. Voltage, Phase, Frequency | 460V, 3 phase, 60 Hz |
| 5. Duty Cycle | Continuous |
| 6. Starting | Reduced Voltage Soft Start |
| 7. Service Factor | 1.15 |
| 8. Maximum Water Temperature | 25°C with a flow velocity of 0.5 fps past the motor |
- B. The motor shall be of the submersible type, capable of continuous operation at nameplate rating submerged under water at a maximum temperature of 25 degrees C ambient water temperature with a minimum of 1/2 foot per second cooling flow velocity past the motor. The motor must be suitable for "across the line" and solid state soft-start starting.
- C. Motor shall be suitable for potable water service. Only FDA approved Food Grade lubricants shall be allowed.
- D. The motor shall be of the water filled, wet winding, type. Water shall contact and surround the winding wires and be circulated throughout the motor interior.
- E. Replaceable carbon composite sleeve type radial bearings shall be provided at each end of the rotor.
- F. The motor shall be equipped with a Kingsbury type pivotal shoe thrust bearing, capable of carrying the weight of all rotating elements plus the hydraulic thrust of the pump at shutoff head.
- G. The motor shall be equipped with an internally connected, continuous lead cable assembly. Each lead cable will be sealed at the mounting bracket to prevent access to the internal components of the motor. The assembly shall consist of one (1) set of three separate, continuous leads. The motor leads shall have a minimum length of 15-feet.
- H. Materials of Construction:
1. Motor housing shall be a baked epoxy coated mild steel or cast iron. Epoxy coating shall meet the requirements of NSF-61. Coating shall be a minimum of dry film thickness (DFT) of 10-mils.
 2. Motor shaft shall be 410 stainless steel and all external fasteners and fittings shall be 300 series stainless steel.

2.10 POWER CABLE

- A. The downhole power cable shall be sized to conform to National Electrical Code for 125 percent of motor full load current at a conductor temperature rating of 75 degrees C submerged, and a voltage drop at the motor not to exceed three percent.
- B. The cable shall have three continuous conductors rated for 600V operations. The individual conductors shall be class "B" stranding or better, with a synthetic rubber or thermoplastic insulation. The three conductor cables shall be contained in a flat or round jacket composed of synthetic rubber or thermo plastic with non-hygroscopic fillers between the conductor cables. The cable shall conform to U.L. Standard 44 or 83 for submersible pump cable.
- C. The cable shall be of sufficient length to allow easy connection in terminal box at the well head.
- D. The motor lead to power cable splice shall be a rubber tape type splice, suitable for continuous submerged operation.
- E. The spliced connection between the motor leads and the power cable shall be HI/POT tested while submerged at the factory prior to shipment.
- F. Power cables shall extend as one continuous length, from the motor lead to power cable splice to the termination external to the well; no intermediate splices (other than the motor lead splice) will be allowed within the well.
- G. Attached cables to pump discharge column pipe with stainless steel clips at 5-ft intervals.

2.11 CONTROL PANEL

- A. General: Motor starters and controls for the pumps shall be provided in a control panel supplied under this specification. The panel shall be NEMA 4X 316 stainless steel and shall have a dead front interior plate. The panel shall be constructed to UL 508A standards and shall bear a UL 508A label. Short circuit current rating of control panel assembly shall meet or exceed the minimums indicated on the drawings, and components shall be chosen as required to satisfy this requirement. Refer to electrical and instrumentation drawings, and Division 16 and 17 specifications for additional design requirements.
- B. Local Control Panel Requirements:
 - 1. Equipment Tag No.: LCP-0109
 - 2. Nameplate: The exterior door of the local control panel shall include a nameplate at top of the panel with the text "Well PW-9 – LCP 0109". The cabinet itself, and all interior and exterior equipment shall be identified with nameplates.
 - 3. Main Circuit Breaker: As indicated on the Electrical Drawing one-line diagram.
 - 4. Motor Starters: Provide Solid State Reduced Voltage Starter (SSRVS) along with a Full-Voltage Non-Reversing (FVNR) bypass starter, as shown on electrical drawings.

5. Panel Controls: Provide controls as indicated on the motor control schematics on the Electrical Drawings and as specified under section entitled "Electric Controls and Relays".
6. Panel Mounted Indicators: Provide indicators as shown on the Electrical Drawings. All indicators shall be readable in direct sunlight.
7. Gauge: Panels shall be minimum 14 USS gauge. Cabinets and panels with any dimension greater than 36 inches shall be 12 USS gauge.
8. Construction: Panels shall be 316 stainless steel NEMA 4X construction.
9. Locks: All cabinets and panels shall be fitted with padlock latch kits.
10. Manufacturer: Panels shall be prefabricated by Hoffman or Rittal.
11. Sunshields: Provide sun shields on top, front, and all sides of outdoor panels. Provide 316 stainless steel mounting hardware. Panel manufacturer shall factory coat sun shields and exposed hardware white.
12. Coordination: Coordinate with Division 17 subcontractor to provide control input/output signals to the remote telemetry unit (RTU) and programmable logic controller (PLC) to be supplied under Division 17.
13. Wire Numbering: Interior panel wiring and field wiring shall be tagged at all terminations with machine-printed plastic sleeves. The wire numbering system and identification tags shall be as specified in Division 16.
14. Wires shall be color coded as follows:

Equipment Ground - GREEN

120 VAC Power - BLACK

120 VAC Power Neutral - WHITE

120 VAC Control (Internally Powered) - RED

120 VAC Control (Externally Powered) - YELLOW

24 VAC Control - ORANGE

DC Power (+) - RED

DC Power (-) - BLACK

DC Control - BLUE

Analog Signal (+) - BLACK

Analog Signal (-) - WHITE

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. General: Pumping equipment shall be installed in accordance with the manufacturer's recommendations and manufacturer's written procedures submitted with the shop drawings. Install pumping equipment in the presence of the manufacturer's technical representative.

3.02 FACTORY TESTS

- A. Factory Certified Performance Curves: After fabrication, and prior to shipment to the jobsite, the CONTRACTOR shall submit factory certified pump performance curves for each pump and motor. The CONTRACTOR shall be responsible for the coordination of a factory performance test of each pump and motor. Tests shall be performed in accordance with the Standards of the Hydraulic Institute, Inc. Tests shall be performed on the actual bowl assemblies to be furnished from shut-off head condition to Operating Point No. 2. Tests shall be performed with certified, lab calibrated, test motors.
- B. Acceptance tolerances shall be in accordance with ANSI/HI 14.6 grade 1E for the design point and grade 3B for other points.

3.03 MOTOR STARTER SETTINGS

- A. General: The motor shall be started by a solid-state reverse voltage starter (SSRVS) or variable frequency drive (VFD) as indicated on the electrical drawings.
- B. Starter Setting Recommendations: The motor manufacturer shall provide written recommended motor starting, operating and stopping guidelines for field adjusting the starter settings.
- C. Starter Settings Inspection Report: The pump supplier shall confirm during startup that the starter settings have been properly adjusted to the voltage ramp settings (for SSRVS) or frequency ramp (for variable frequency drive equipped pumps) recommended by the motor manufacturer.

3.04 FIELD TESTS

- A. Field Tests: All pumping units shall be field tested after installation, to demonstrate satisfactory operation, without causing excessive noise, vibration, cavitation, and overheating of the bearings. The field testing shall be performed in the presence of an experienced field representative of the manufacturer of each major item of equipment, who shall supervise the following tasks and shall certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted, and readied for operation.
- B. See Section "Equipment Startup and Testing" for additional requirements.

3.05 TOOLS, SUPPLIES, AND SPARE PARTS

- A. Each pump shall be furnished with the following spare parts:

1. Set of gaskets and seals
2. Set of pump bowl assembly bearings
3. Replaceable bowl and impeller wear rings (all stages)
4. Five fuses of each size used in the well local control panel
5. Others as recommended by the manufacturer

- END OF SECTION -

SECTION 12400 - LABORATORY EQUIPMENT

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall furnish and install Laboratory Equipment with all spare parts, accessories and appurtenances required for a complete installation as shown on the Drawings and specified herein.

1.02 SUBMITTALS

- A. The CONTRACTOR shall submit shop drawings, technical materials, performance data, including manufacturer's brochures and catalog cuts for each item in accordance with the Section entitled "Submittals."

PART 2 – PRODUCTS

2.01 PORTABLE WATER QUALITY MULTIMETER

- A. Hach SL1000 Portable Parallel Analyzer Kit
- B. Hach Model No. 9499000
- C. Quantity: 1
- D. Deliver to Water Treatment Plant Chief Operator.

2.02 CLASSROOM TRAINING

- A. The Contractor shall retain Hach to provide classroom training to the Owner's personnel on the operation and maintenance of the analyzer described in Article 2.01.
- B. Training Location: Hallandale Beach Water Treatment Plant
- C. Training Sessions: One morning training session and one afternoon training session.
- D. Trainer: The trainer shall be supplied by Hach with expertise in the operation and maintenance of the analyzer described in Article 2.01.

PART 3 – EXECUTION (NOT USED)

- END OF SECTION -

SECTION 15000 - PIPING, GENERAL

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install all piping systems shown and specified, in accordance with the requirements of the Contract Documents. Each system shall be complete with all necessary fittings, hangers, supports, anchors, expansion joints, flexible connectors, valves, accessories, lining and coating, testing, disinfection, excavation, and backfill, to provide a functional installation.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Division 1
- B. Excavation and Backfill for Utilities
- C. Painting
- D. Pipe Supports
- E. Pipeline Testing and Disinfection

1.03 SUBMITTALS

- A. The Contractor shall submit complete shop drawings and certificates, test reports, affidavits of compliance, of all piping systems, in accordance with the requirements in the Section entitled "Submittals", and as specified in the individual piping sections.
- B. Each shop drawing submittal shall be complete in all aspects incorporating all information and data listed herein and all additional information required to evaluate the proposed piping material's compliance with the Contract Documents. Partial or incomplete submissions will be returned to the Contractor without review.
- C. Data to be submitted shall include, but not be limited to:
 - 1. Catalog Data consisting of specifications, illustrations and a parts schedule that identifies the materials to be used for the various piping components and accessories. The illustrations shall be in sufficient detail to serve as a guide for assembly and disassembly.
 - 2. Complete layout and installation drawings with clearly marked dimensions and elevations. Piece numbers which are coordinated with the tabulated pipe layout schedule shall be clearly marked. Piping layout drawings shall indicate the following additional information; pipe supports, location, support type, hanger rod size, insert type and the load on the hanger in pounds.
 - 3. Weight of all component parts.
 - 4. Design calculations when requested.
 - 5. Tabulated pipe layout schedule which shall include the following information for all pipe and fittings: service, pipe size, working pressure, wall thickness and piece number.
- D. Certifications: Prior to installation, the Contractor shall furnish an Affidavit of Compliance certified by the pipe manufacturer that the pipe, fittings and specials furnished under this Contract comply with all applicable provisions of AWWA and these specifications. No pipe or fittings will be accepted for use in the Work on this project until the affidavits have been submitted and accepted in accordance with the Section entitled "Submittals".

- E. All expenses incurred in making samples for certification of tests shall be borne by the Contractor.
- F. Verification of Existing Pipeline Sizes and locations prior to ordering pipe, fittings or valves. The Contractor shall verify all locations of existing system components to be tied into the new water piping prior to ordering any fittings or other components that must match proper sizes and locations. The Contractor assumes full responsibility for materials ordered prior to verifying required sizes and dimensions in the field.

1.04 QUALITY ASSURANCE

- A. Tests: Except where otherwise specified, all materials used in the manufacture of the pipe shall be tested in accordance with the applicable Specifications and Standards.
- B. Welding Requirements: All welding procedures used to fabricate pipe shall be prequalified under the provisions of ANSI/AWS D1.1. Welding procedures shall be required for, but not necessarily limited to, longitudinal and girth or spiral welds for pipe cylinders, spigot and bell ring attachments, reinforcing plates and ring flange welds, and plates for lug connections.
- C. Welder Qualifications: All welding shall be done by skilled welders, welding operators, and tackers who have had adequate experience in the methods and materials to be used. Welders shall be qualified under the provisions of ANSI/AWS D1.1 by an independent local, acceptable testing agency not more than 12 months prior to commencing work. Machines and electrodes similar to those used in the Work shall be used in qualification tests. The Contractor shall furnish all material and bear the expense of qualifying welders. Furnish welder's qualification papers to the Engineer.

1.05 MANUFACTURER'S SERVICE REPRESENTATIVE

- A. Where the assistance of a manufacturer's service representative is advisable, in order to obtain correct pipe joints, supports, or special connections, the Contractor shall furnish such assistance at no additional cost to the Owner.

1.06 MATERIAL DELIVERY, STORAGE, AND PROTECTION

- A. All piping materials, fittings, valves, and accessories shall be delivered in clean and undamaged conditions and stored off the ground, to provide protection against oxidation caused by ground contact. All defective or damaged materials shall be replaced with new materials.

1.07 CLEANUP

- A. After completion of the work, all remaining pipe cuttings, joining and wrapping materials, and other scattered debris, shall be removed from the site. The entire piping system shall be handed over in a clean and functional condition.

PART 2 - PRODUCTS

2.01 GENERAL

- A. All pipes, fittings, and appurtenances shall be installed in accordance with the requirements of the applicable Sections of Division 2 - Sitework and Division 15 - Mechanical and furnished as specified herein.
- B. Pipe Supports: All pipes shall be adequately supported in accordance with the requirements of the Section entitled "Pipe Supports", and/or as shown.
- C. Coating: All requirements pertaining to thickness, application, and curing of pipe coating, are in accordance with the requirements of the applicable Sections of Division

15 - Mechanical, unless otherwise specified. Pipes above ground or in structures shall be field painted in accordance with the Section entitled "Painting"

- D. Lining: All requirements pertaining to thickness, application, and curing of pipe lining, shall be in accordance with the requirements of the applicable Sections of Division 15 – Mechanical, unless otherwise specified.
- E. Pressure Rating: All piping systems shall be designed for the rated working pressure, listed in the piping schedule.

2.02 PIPE FLANGES

- A. Flanges: Where the design pressure is 150 psi or less, flanges shall conform to either ANSI/AWWA C115/A21.15 Class D or ANSI B16.1 125-lb class. Flanges shall have flat faces and shall be attached with bolt holes straddling the vertical axis of the pipe unless otherwise shown. Attachment of the flanges to the pipe shall conform to the applicable requirements of ANSI/AWWA C115/21.15. Flanges for miscellaneous small pipes shall be in accordance with the standards specified for these pipes.
- B. Blind Flanges: Blind flanges shall be in accordance with ANSI/AWWA C207, or with the standards for miscellaneous small pipes. All blind flanges for pipe sizes 12-inches and over shall be provided with lifting eyes in the form of welded or threaded eye bolts.
- C. Flange Coating: All machined faces of metal blind flanges and pipe flanges shall be coated with a temporary rust-inhibitive coating to protect the metal until the installation is completed.
- D. Flange Bolts: If studs are required, they shall be in accordance with ASTM A307, Grade B, with heavy hex nuts. Machine bolts shall normally be used on all flanged connections and shall be in accordance with ASTM A307, Grade B, with heavy hex nuts. If studs are required, they shall extend through the nuts a minimum of ¼-inch. All bolts and nuts shall be hot dipped galvanized and shall conform to the Section entitled "Metal Fabrications".
- E. Flange Gaskets: Gaskets for flanged joints shall be of materials as specified in piping sections. Blind flanges shall have gaskets covering the entire inside face of the blind flange and shall be cemented to the blind flange. Ring gaskets shall not be permitted.
- F. Flange Gasket Suppliers shall be John Crane, Garlock or equal

2.03 GROOVED COUPLINGS

- A. General: Mechanical-type couplings shall be provided where shown. Buried or submerged couplings shall have Type 316 stainless steel bolts and nuts conforming to the requirements of the Section entitled "Metal Fabrications".
- B. Stainless steel pipe couplings shall conform to Section entitled "Stainless Steel Pipe".
General: Grooved couplings shall be provided where shown on the Drawings. Buried or submerged couplings shall have Type 316 stainless steel bolts and nuts conforming to the requirements of Section entitled "Metal Fastening".
- C. Coatings
 - 1. Aboveground: Factory coated enamel.
 - 2. Buried: Two coats of coal tar epoxy (3 mils DFT each coat).
- D. Steel Pipe Couplings
 - 1. Suppliers shall be Victaulic Style 77 (grooved), or equal
 - 2. Gaskets: Shall be Grade "E", EPDM

E. Ductile Iron Pipe Couplings

1. Suppliers shall be Victaulic Style 31, or equal
2. Gaskets: Shall be Grade "M" halogenated butyl.

F. PVC Pipe Couplings

1. Suppliers shall be Victaulic Style 775, or equal
2. Gaskets: Shall be Grade "E" EPDM

2.04 GROOVE FITTING FLANGE ADAPTERS FOR DUCTILE IRON PIPE

- A. Grooved/flanged adapters for ductile iron pipe shall be used to facilitate connection from grooved fittings to flanged valves, pumps, pipe, fittings, and other flanged components. The flange adapters shall be ductile iron conforming to ASTM A-536, Grade 65-45-12, 3 - 24" (DN80 - DN600) size range. Gaskets shall have properties as designated by ASTM D-2000 of the same specially compounded elastomer as the couplings, and shall be suitable for the required service. Grooved/flanged adapters shall be Victaulic, Style 341, or equal.

2.05 MECHANICAL COUPLINGS

- A. Construction: Sleeve-type couplings shall be provided where shown, and shall be of similar material as the pipe, without pipe stop, and shall be of sizes to fit the pipe and fittings shown. The middle ring shall be not less than ¼-inch in thickness and shall be either 5 or 7-inches long for standard steel couplings, and 16-inches long for long-sleeve couplings. The followers shall be single-piece contoured mill section welded and cold-expanded as required for the middle rings. They shall be of sufficient strength to accommodate the number of bolts necessary to obtain adequate gasket pressures without excessive rolling. The shape of the follower shall be of such design as to provide positive confinement of the gasket. Bolts and nuts shall conform to the requirements of the Section entitled "Metal Fabrications".
- B. Pipe Preparation: The ends of the pipe, where specified or shown, shall be prepared for sleeve-type couplings. Plain ends for use with couplings shall be smooth and round for a distance of 12-inches from the ends of the pipe, with outside diameter not more than 1/64-inch smaller than the nominal outside diameter of the pipe. The middle ring shall be tested by cold-expanding a minimum of one percent beyond the yield point, to proof-test the weld to the strength of the parent metal. The weld of the middle ring shall be subjected to an air test for porosity.
- C. Gaskets: Gaskets for sleeve-type couplings shall be rubber-compound material that will not deteriorate from age or exposure to air under normal storage or use conditions. The rubber in the gasket shall meet the following specifications:
1. Color - Jet Black
 2. Surface - Nonblooming
 3. Durometer Hardness - 74 ± 5
 4. Tensile Strength - 1000 psi Minimum
 5. Elongation - 175 percent Minimum
- D. The gaskets shall be immune to attack by the material which is being transported. All gaskets shall meet the requirements of ASTM D 2000, AA709Z, meeting Suffix B13 Grade 3, except as noted above.

- E. Bolts, nuts and washers shall be ASTM A193, Grade B7 for above-ground applications. Buried applications shall use 316 stainless steel hardware.
- F. Coatings: Couplings shall be shop primed with a primer compatible with the painting system specified in the Section entitled "Painting".
- G. Insulating Couplings: Where insulating couplings are required, both ends of the coupling shall have a wedge-shaped gasket which assembles over a rubber sleeve of an insulating compound in order to obtain insulation of all coupling metal parts from the pipe.
- H. Restrained Joints: Where harnesses are required for sleeve-type couplings, they shall be in accordance with the requirements of the appropriate reference standard, or as shown.
- I. Supplier shall be Rockwell (Smith-Blair), Style 411, Dresser, Style 38, Ford Meter Box Co., Inc., Style FC1 or FC3 or equal.

2.06 FLANGED COUPLING ADAPTERS

A. Reference Standards:

1. AWWA C207 Steel Pipe Flanges for Waterworks Service—Sizes 4 In. Through 144 In.
2. AWWA C213 Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines
3. AWWA C219 Standard for Bolted, Sleeve-Type Couplings for Plain-End Pipe
4. ASTM A36 Standard Specification for Carbon Structural Steel
5. ASTM A513 Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing
6. NSF 61 Drinking Water System Components - Health Effects

B. Product Standard: Flanged coupling adapters shall comply with AWWA C219.

C. Flange Dimensions: Flanges shall meet the requirements of AWWA C207. Flanges shall be Class D. Bolt circle dimensions shall be compatible with ANSI Class 125 and 150.

D. Pressure Capacity: 150 psi.

E. Materials:

Item	Material
Coupling Body and Flange	Carbon Steel
Follower (a.k.a. end ring)	Carbon Steel
Bolts and Nuts	316 Stainless Steel
Gasket	Material to be selected by manufacturer. Selected material shall be suitable for water service with chloramine residual of 2 mg/L

- F. Factory Applied Exterior Coating: Fusion bonded epoxy per AWWA C213 with a minimum 12 mils dry film thickness (DFT). Coating shall be suitable for contact with potable water per NSF International Standard 61.
- G. Factory Applied Interior Lining: The lining shall match the coating.
- H. Harnessing: All flanged coupling adapters shall be harnessed to the wall by using 316 stainless steel tie rods, 316 stainless steel nuts and 316 stainless steel tabs.
- I. Manufacturer: Romac Style FC400, Dresser Style 128-W, Smith Blair Corporation, or equal.

2.07 RESTRAINED FLANGE ADAPTER

- A. General: Restrained flange adapters shall be used where shown on the Drawings to connect existing plain end ductile iron pipe to proposed stainless steel flanged piping. The proposed stainless steel flanged piping shall have AWWA C107 Class D flanges.
- B. Body Material: The restrained flange adapter ring body shall be made of ductile iron conforming to ASTM A536.
- C. Gaskets: Sealing gaskets shall be EPDM.
- D. Factory Applied Internal Lining: All internal surfaces of wetted parts shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to AWWA C213 titled "Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines". Lining shall be suitable for contact with potable water per NSF International Standard 61.
- E. Factory Applied Exterior Coating: Exterior surfaces shall be coated with a minimum of 6 mils of fusion bonded epoxy per AWWA C116 titled "Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fitting".
- F. Flange Bolt Pattern: The adapter shall have flange bolt circles that are compatible with AWWA C107 Class D flanges.
- G. Restraint: Restraint for the flange adapter shall consist of a plurality of individual actuated gripping wedges to maximize restraint capability. Torque limiting actuating screws shall be used to insure proper initial set of gripping wedges.
- H. Deflection Capability: Restrained flange adapters shall be capable of deflection during assembly, or permit lengths of pipe to be field cut, to allow a minimum of 0.6" gap between the end of the pipe and the mating flange without affecting the integrity of the seal.
- I. Manufacturer: SERIES 2100 MEGAFLANGE, as produced by EBAA Iron, Inc., or equal.

2.08 SLEEVES

- A. Pipe sleeves shall be provided where shown on the Drawings. All PVC pipe passing through cast-in-place concrete walls or slabs shall be provided with a sleeve whether or not shown on the Drawings.
- B. Except for core drilled holes in existing concrete, sleeves shall be equipped with a waterstop centered in the wall penetration.
- C. As a minimum, sleeves shall be of the same material as the pipe passing through it.
- D. Sleeves shall be of sufficient size to pass the pipe and any required coverings of the pipe and shall extend two (2) inches above finished floor.
- E. Sleeves shall be caulked with a fire retardant caulking compound at fire walls and a gas tight compound at gas tight walls.

- F. All sleeves penetrating water/wastewater tanks or wet wells and all below grade walls or floors shall be provided with penetration seals, "Link Seal" as manufactured by Thunderline Corporation, or equal. Penetration seals shall be covered with a two part polysulfide sealant on the earth or wet side of the sleeve and penetration seal as shown on the Drawings.
- G. All sleeves in building interiors shall be sealed with foam sealant and caulking as shown on the Drawings.

2.09 WALL PIPES

- A. Wall pipes shall be provided where shown on the Drawings. All wall pipes and castings shall be equipped with waterstops and shall be of the same material as the connecting piping. The wall pipes shall have the interior and exterior protection as specified for the connecting piping.
- B. Wall pipes shall be of sufficient length to pass through the wall in accordance with the details on the Drawings and shall conform to the details shown on the Drawings. The end of the wall pipes shall be of a type consistent with the piping to be connected to them and shall conform to their standards and specifications.

2.10 SOLID SLEEVE COUPLINGS

- A. Solid sleeve couplings shall be used to connect buried service piping where shown on the Drawings. Solid sleeves shall be ductile iron, long body and shall conform to the requirements of ANSI A21.10 (AWWA C110). Unless otherwise shown or specified, solid sleeve couplings shall be Style A11760 as manufactured by American Cast Iron Pipe Co., or equal.

2.11 UNIONS

- A. For ductile iron, carbon steel, and grey cast iron pipes assembled with threaded joints and malleable iron fittings, unions shall conform to ANSI B16.39.
- B. For copper piping, unions shall have ground joints and conform to ANSI B16.18.
- C. For PVC and CPVC piping, unions shall be socket weld type with Viton O-ring.

2.12 VENT AND DRAIN VALVES

- A. For liquid pipelines, the Contractor shall install drain valves and vent valves, whether shown on the Drawings or not, at the low points and high points, respectively.

2.13 WATERTIGHT LINK SEALS

- A. Application Location: Furnish watertight link type seals where indicated on the Drawings.
- B. Type: Interconnected synthetic rubber links shaped and sized to continuously fill annular space between pipe and wall sleeve opening.
- C. Materials: Assemble interconnected rubber links with Type 316 stainless steel bolts, nuts, and pressure plates. Elastomeric sealing material shall be as recommended by the manufacturer for the application.
- D. Sizing Criteria: Size modular mechanical seals according to manufacturer's instructions for the size of pipes shown to provide a watertight seal between pipe and wall sleeve opening or core drilled opening in existing walls (when sleeves are not indicated on the Drawings).
- E. Manufacturers and Products (or Equal):
 - 1. Thunderline/LinkSeal, Div. Of PSI, Houston, TX; Link Seal;

2. Calpico, Inc., South San Francisco, California; Sealing Linx;
3. Advance Products and Systems, Lafayette, Louisiana; Innerlynx.

2.14 METALLIZED WARNING TAPE

- A. For all buried pipe, cable and conduits furnish and install 3-inch detectable marking tape, of appropriate color and appropriate warning statement along the entire length. In all cases, marking tape shall be installed 12 inches below the finished grade during backfill operations. Metallized tape shall be Terra Tape D as manufactured by Reef Industries, Inc., Houston Texas or approved equal.

PART 3 - EXECUTION

3.01 GENERAL

- A. The Contractor shall furnish all labor, tools, materials, and equipment necessary for installation and jointing of the pipe. All piping shall be installed in accordance with the Drawings in a neat workmanlike manner and shall be set for accurate line and elevation. All piping shall be thoroughly cleaned before installation, and care shall be taken to keep the piping clean throughout the installation.
- B. Before setting wall sleeves, pipes, castings and pipes to be cast in place, the Contractor shall check the Drawings and equipment manufacturer's drawings which may have a direct bearing on the pipe locations. The Contractor shall verify existing piping tie-in connections and verify size, type, and location before fabricating new piping assemblies.
- C. Piping shall be attached to pumps, valves, equipment, etc., in accordance with the respective manufacturers' recommendations. This includes the use of flexible connectors as required.
- D. For piping assembled with threaded, solvent cemented, welded or soldered joints, liberal use of unions shall be made. Unions shall be provided close to main pieces of equipment and in branch lines to permit ready dismantling of piping without disturbing main pipe lines or adjacent branch lines. A minimum of one union per straight run of pipe between fitting and/or valves with multiple lengths of pipe shall be used.
- E. All changes in directions or elevations shall be made with fittings, unless otherwise shown.

3.02 SHIPPING, HANDLING AND STORAGE

- A. Special care in handling shall be exercised during delivery, distribution and storage of pipe to avoid damage and setting up stresses. Damaged pipe will be rejected and shall be replaced at the Contractor's expense. Pipe and specials stored prior to use shall be stored in such a manner as to keep the interior free from dirt and foreign matter.
- B. No pipe shall be dropped from cars or trucks to the ground. All pipe shall be carefully lowered to the ground by mechanical means. In shipping, pipe and fittings shall be blocked in such manner as to prevent damage to castings or lining. Any broken or chipped lining shall be carefully patched. Where it is impossible to repair broken or damaged lining in pipe because of its size, the pipe shall be rejected as unfit for use.
- C. All mechanical joint pipe shall be laid with 1/8-inch space between the spigot and shoulder of pocket.
- D. Contractor shall protect all susceptible materials from UV degradation.

3.03 LAYING PIPE

- A. Proper and suitable tools and appliances for the safe convenient handling and laying of pipe shall be used and shall, in general, agree with manufacturer's recommendations. At the time of laying, the pipe shall be examined carefully for defects, and should any pipe be discovered to be defective after being laid, it shall be removed and replaced with sound pipe by the Contractor at his expense.
- B. The Contractor shall perform all earthwork including excavation, backfill, bedding, compaction, sheeting, shoring and bracing, dewatering and grading in accordance with the Section entitled "Excavation and Backfill for Utilities".
- C. Upon satisfactory excavation of the pipe trench and completion of the pipe bedding, a continuous trough for the pipe barrel and recesses for the pipe bells, or couplings, shall be excavated by hand digging. When the pipe is laid in the prepared trench, true to line and grade, the pipe barrel shall receive continuous, uniform support and no pressure shall be exerted on the pipe joints from the trench bottom.
- D. All piping 3-inches and larger shall be provided with two 4-foot lengths of pipe for the first two joints outside a building or tank wall unless a greater number of joints is shown on the Drawings.
- E. Pipe shall be installed in accordance with the manufacturer's recommendation. Before being lowered into the trench, the pipes and accessories shall be carefully examined and the interior of the pipes shall be thoroughly cleaned of all foreign matter. At the close of each work day and during suspension of work for any reason at any time, a suitable stopper shall be placed in the end of the pipe last laid to prevent mud or other foreign material from entering the pipe.
- F. Lines shall be laid straight and depth of cover shall be maintained uniform with respect to finish grade, whether grading is completed or proposed at time of pipe installation. Where a grade or slope is shown on the Drawings, the Contractor shall use laser based surveying instruments to maintain alignment and grade. At least one elevation shot shall be taken on each length of pipe and recorded. No abrupt changes in direction or grade will be allowed.
- G. After pipe has been laid, inspected and found satisfactory, sufficient backfill shall be placed along the pipe barrel to hold the pipe securely in place during the conduction of the hydrostatic test. No backfill shall be placed over the joints until the hydrostatic tests is satisfactorily completed, leaving the joints exposed to view for the detection of visible leaks. Upon satisfactory completion of the hydrostatic test, backfilling of the trench shall be completed. Pipe trenches may be backfilled prior to hydrostatic testing subject to the permission of the Engineer.
- H. All underground piping and fittings shall use restrained joints.

3.04 FLANGED JOINTS

- A. Flanged joints shall be made up with full face gaskets as specified in the piping paragraphs. Flange faces shall have a uniform bearing on the gaskets. Flanges shall be drawn together uniformly until the joint is tight. No washers shall be permitted for the bolt and nut assemblies. The length of the bolts shall be uniform and in accordance with the standards specified herein. The bolt's maximum projection beyond the end of the nut shall be 0.25-inch and shall not fall short of the end of the nut. All buried flanges shall be installed with Type 316 SS nuts and bolts.

3.05 WELDED JOINTS

- A. Welded joints shall be in accordance with the requirements of the Section entitled "Stainless Steel Pipe".

- B. Field welding will be permitted for black carbon steel pipe where it can be demonstrated that the interior of the pipe can be satisfactorily lined and inspected. Welding in the field shall be performed only when requested on the shop drawings and accepted by the Owner and Engineer in writing as specified herein.
- C. All welding shall be performed in accordance with ANSI B31.1 and AWWA C 206 except as modified or supplemented herein. All welders shall be AWS certified in accordance with AWWA C206, and ANSI B31 requirements.
- D. Pipe and fittings with wall thicknesses of 3/16-inch and larger shall have ends beveled for welding. Bevels shall be 30 degrees with a maximum of 37-1/2 degrees. The abutting pipe ends shall be separated before welding to permit complete fusion to the inside wall of the pipe without overlapping. Welding shall be continuous around the joint and shall be completed without interruption. Welds shall be of the single vee butt type, of sound weld metal thoroughly fused into the ends of the pipe and into the bottom of the vee. Welds shall be free from cold spots, pin-holes, oxide inclusions, burrs, snags, rough projections or other defects.
- E. Filler metal for welding shall be of the same composition as the base metal. All welding of steel pipe flanges shall be in accordance with requirements of AWWA C207 and ANSI B31.1.
- F. Field repairs of cement mortar lining welded joints shall be made in accordance with AWWA C205 or AWWA C602.
- G. Field welds shall be "fixed position" type.

3.06 THREADED JOINTS

- A. All threads shall be clean, machine cut and all pipe shall be reamed before erection. Taps and dies shall be cleaned, sharpened and in good condition. All threaded joints shall be made tight with Teflon tape.
- B. After having been set up, a joint shall not be backed off unless the joint is broken, the threads cleaned and new tape is applied.

3.07 SOLVENT CEMENTED JOINTS

- A. Joints shall be made up in accordance with ASTM D 2855 and the manufacturers' recommendations. The Contractor is advised to handle the solvent cements in accordance with ASTM F 402.

3.08 THRUST RESTRAINT

- A. All sleeve type couplings shall be harnessed except where noted specifically on the Drawings. The harnessing shall be as shown on the Drawings or as specified herein.
- B. Where the distance between adjacent flanges is in excess of ten feet or where a harness can not be used, the pipe supports adjacent to the coupling shall restrain the piping preventing any linear or angular movement resulting in the pipe separating from the coupling or misalignment in the joint.
- C. Where expansion joints are used, control units shall be provided. All tie rods and control units shall be installed in accordance with manufacturer recommended procedures.
- D. All tie rods and associated hardware shall be Type 316 stainless steel.
- E. In general, all valves and fittings shall be restrained in an acceptable manner such that the unbalanced force developed at them shall be supported independent of the piping system.

3.09 PIPING SCHEDULE

- A. This section includes schedule of piping specified in other sections of Division 15 - Mechanical.
- B. The following abbreviations are used in the schedule:

- 1. Material

BSP	Black Steel Pipe
CIP	Cast Iron Pipe
CPVC	Chlorinated Polyvinyl Chloride
Cu	Copper
DIP	Ductile Iron Pipe
GSP	Galvanized Steel Pipe
PTFE	Polytetrafluorethylene
PVC	Polyvinylchloride
SS	Type 316L Stainless Steel

- 2. Wall Thickness

CL	Class
DR	Diameter Ratio
Sch	Schedule
SDR	Standard Diameter Ratio

- 3. Joint Type

Comp	Compression
Grvd	Grooved
Flg	Flanged
PO	Push on Joint
RJ	Restrained Joint
MJ	Mechanical Joint
Sld	Soldered
SW	Solvent Welded
Thd	Threaded
Wld	Welded

- 4. Fitting Type

SS	Type 316L Stainless Steel
DIP	Ductile Iron Pipe
PVC	Polyvinylchloride
CPVC	Chlorinated Polyvinyl Chloride
Gal	Galvanized

BSP Black Steel Pipe
Cu Copper
PTFE Polytetrafluorethylene

5. Interior Surface Protection

CML Cement Mortar Lined

6. Exterior Surface Protective Coating

AC Asphalt Coated

P Painted

C. Piping Schedule

Service	Nominal Pipe Diameter (inches)	Material	Thickness	Working Pressure (PSIG)	Joints	Fittings	Protective Coating		Remarks
							Interior	Exterior	
Raw Water Below Grade	4 inch and over	DI	Pressure Class 350	150	MJ or RJ	DI	CML	AC	--
Raw Water Above Grade	All	DI	Special Thickness Class 53	150	Flg	DI	CML	P	

- END OF SECTION -

SECTION 15006 - DUCTILE IRON PIPE

PART 1 -- GENERAL

1.01 WORK INCLUDED

- A. The Contractor shall furnish and install ductile iron pipe and all appurtenant Work, complete in place, all in accordance with the requirements of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Materials and Equipment
- B. Excavation and Backfill for Utilities
- C. Submittals
- D. Painting
- E. Piping, General
- F. Pipeline Testing and Disinfection

1.03 REFERENCED SPECIFICATIONS, CODES, AND STANDARDS

- A. Commercial Standards:

ANSI/AWWA C104/A21.4	Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water
ANSI/AWWA C110/A21.10	Ductile-iron and Gray-Iron Fittings 3-in. Through 60-in. for Water and Other Liquids
ANSI/AWWA C111/A21.11	Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings
ANSI/AWWA C150/A21.50	Thickness design of ductile iron pipe
ANSI/AWWA C151/A21.51	Ductile-iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids
ANSI/AWWA C600	Installation of Ductile-Iron Water Mains and Appurtenances

1.04 SUBMITTALS

- A. Shop Drawings: The Contractor shall submit Shop Drawings of pipe and fittings in accordance with the requirements set forth in the Sections entitled – “Piping, General” and “Submittals”.
- B. Contractor shall submit certification that all materials coming in contact with potable water comply with the requirements of NSF 61.

1.05 SCHEDULE OF PIPING MATERIALS

- A. A schedule of piping materials is included in the Section entitled "Piping, General". The schedule indicates service, nominal pipe size, material, wall thickness, joint type, working pressure, restraint design pressure, test pressure, coatings and linings.

PART 2 -- PRODUCTS

2.01 GENERAL

- A. Pipe shall be centrifugally cast in metal molds or sand lined molds in accordance with ANSI A21.51 (AWWA C151) of grade 60-42-10 ductile iron. The above standard covers ductile iron pipe with nominal pipe sizes from three inches up to and including sixty-four inches in diameter. Working pressure shall be as specified herein, unless higher pressure is indicated on the Piping Schedule in Section 15000 – Piping, General.

B. Wall Thickness

1. Buried Pipe: Pressure Class 350
2. Flanged Pipe: Pipe wall thickness of threaded pipe for a flanged pipe end shall be minimum special thickness Class 53 from 4-inch to 54-inch and/or minimum pressure Class 350 for 60-inch to 64-inch diameter pipe in accordance with AWWA C115.
3. Grooved Pipe: Grooved coupling pipe shall be special thickness Class 54.
 - a. 4"-16" diameter: Special Thickness Class 53
 - b. 18" diameter: Special Thickness Classes 54
 - c. 20" diameter: Special Thickness Classes 55
 - d. 24"-36" diameter: Special Thickness Class 56

C. Joints

1. Ductile iron pipe above grade shall be flanged.
2. All pipe and fittings below grade shall be restrained joint type.
3. Mechanical and push-on type joints shall be in accordance with ANSI A21.11 (AWWA C111).
4. Flanges for flanged pipe shall be in accordance with ANSI A21.15 (AWWA C115), shall be ductile iron, shall be rated at 250 psi maximum working pressure, and shall be similar to flange Class 125 per ANSI B16.1. Where shown on the Drawings, pipe and fittings shall be furnished with flanges similar to flange Class 250 per ANSI B16.1. Fittings shall be provided with flanges having a bolt circle and bolt pattern the same as the adjacent pipe and/or mechanical devices.
5. Bolts: hot dip galvanized carbon steel bolts and nuts.

6. No raised face flanges shall be used. The raised faces shall be milled flat.
7. Gasket Material: Gaskets shall be red rubber styrene butadiene (SBR).

D. Restrained Joints

1. All ductile iron pipe and fittings below grade shall be restrained joint.
2. Manufactured Proprietary Restrained Joint Piping and Fittings: Restrained joint pipe and fittings shall be Flex-Ring or Lok-Ring type as manufactured by American Cast Iron Pipe, TR Flex as manufactured by U.S. Pipe, or equal.
3. Restrained Mechanical Joint Fittings: All mechanical joint fittings, valves and appurtenances shall be restrained as described herein. The restraint rings shall be manufactured of ductile iron conforming to ASTM A536 and incorporate a plurality of individually-actuating gripping surfaces to grip the pipe. The restraint device shall be coated in MEGA-BOND Restraint Coating System. The restraint system shall consist of two series 1100 MEGALUGS mechanical joint restraint follower glands with the second follower gland having the mechanical joint lip removed at the factory to seat properly behind the first. The restraint system shall have a sufficient number of fastening bolts to connect the rings to the mechanical joint. Torque limiting twist off nuts shall be used to ensure proper actuation of the restraining wedges. The restraint system shall have a minimum safety factor of 2 to 1. The restraint system shall be the Series 1100TDM Tandem MEGALUG Mechanical Joint Restraint manufactured by EBAA Iron, Inc., or equal.
4. Restraining System for Field Cut Piping: Use only in areas where adjoining to fixed points where laying length is determined in field and requires field cutting of the pipe. Ductile iron pipe bell restraint shall consist of a wedge action restraint ring on the spigot joined to a split ductile iron ring behind the bell. The restraint ring shall have individually actuated wedges that increase their resistance to pull-out as pressure or external forces increase. Torque limiting twist off nuts shall be used to ensure proper actuation of the restraining wedges. The restraint devices shall be coated using MEGA-BOND. The product shall be the Series 1700 Megalug restraint harness, manufactured by EBAA Iron, Inc., or equal.

E. Fittings

1. General: Fittings shall be manufactured in accordance with AWWA C110 or AWWA C153 or the manufacturer's standard.
3. Materials: Fittings shall be ductile iron.
4. Joints - General: Fittings shall be either flanged, mechanical joint or manufactured proprietary restrained joint type as indicated on the Drawings and specified herein.
5. Flanged Joint Fittings: Above ground fittings shall be flanged.
6. Manufacturer Proprietary Restrained Joint Fittings: All below ground fittings 30-inches in diameter and greater shall be manufacturer proprietary restrained joint type.

7. Mechanical Joint Fittings: Underground ductile iron fittings 24-inches in diameter and less shall be mechanical joint type fittings.

F. Joint Pressure Ratings:

1. Flanged Joints: The flanges shall be rated for at least 250 psi working pressure.
2. Grooved Joints:
 - a) Fittings 4 to 36-inch Diameter with Grooved Joints: Maximum 250 psi working pressure.
 - b) Grooved Couplings 4 to 18-inch Diameter: Maximum 250 psi working pressure
 - c) Grooved Couplings 20 to 36-inch Diameter: Maximum 150 psi working pressure.
3. Restrained, Push-on and Mechanical Joints:
 - a) 4 to 24-inch Diameter: Maximum 350 psi working pressure.
 - b) 30 to 64-inch Diameter: Maximum 250 psi working pressure.

F. Pipe Lining and Coating General: Pipe linings and coatings shall be as follows.

4. Buried Service: The piping manufacturer's standard asphaltic coating shall be applied prior to shipment to the exterior wall of buried pipe and fittings in accordance with AWWA C151.
5. Above Ground Piping and Exposed Piping within Underground Vaults: A coating of rust inhibitive primer, compatible with the coating system specified in Section 09900 – Painting, shall be applied to the pipe exterior prior to shipment for piping that is above ground and exposed piping within vaults. Primer shall be compliant with NSF Standard 61.
6. Cement-Mortar Lining: Pipe and fittings shall be cement-lined and seal-coated in accordance with AWWA C104, Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.

F. Color Coding for Potable Water Mains:

1. Above Ground Piping: Pipe used for potable water main applications in above ground service shall be painted blue.
2. Below Ground Piping: Pipe used for potable water main applications in below ground service shall have a continuous blue line painted along the top of the pipe.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. The Contractor shall perform all earthwork including excavation, backfill, bedding, compaction, sheeting, shoring and bracing, dewatering and grading in accordance with Division 2 - Sitework.
- B. Unless otherwise directed, ductile iron pipe shall be laid with the bell ends facing upstream in the normal direction of flow and in the direction of laying.
- C. Thrust restrained and mechanical joints shall be made in accordance with the manufacturer's standards except as otherwise specified herein. Joints between mechanical joint pipe and/or fittings shall be made in accordance with ANSI/AWWA Standard C600, except that deflection at joints shall not exceed one-half of the manufacturer's recommended allowable deflection, or one-half of the allowable deflection specified in ANSI/AWWA C600, whichever is the lesser amount.
- D. Before laying thrust restrained and mechanical joint pipe and fittings, all lumps, blisters and excess bituminous coating shall be removed from the bell and spigot ends. The outside of each spigot and the inside of each bell shall be wire brushed, and wiped clean and dry. The entire gasket groove area shall be free of bumps or any foreign matter which might displace the gasket. The cleaned spigot and gasket shall not be allowed to touch the trench walls or trench bottom at any time. Vegetable soap lubricant shall be applied in accordance with the pipe manufacturer's recommendations, to aid in making the joint. The workmen shall exercise caution to prevent damage to the gasket or the adherence of grease or particles of sand or dirt. Deflections shall only be made after the joint has been assembled.
- E. Prior to making up flanged joints in ductile iron pipe and fittings, the back of each flange under the bolt heads and the face of each flange shall have all lumps, blisters and excess bituminous coating removed and shall be wire brushed and wiped clean and dry. Flange faces shall be kept clean and dry when making up the joint, and the workmen shall exercise caution to prevent damage to the gasket or the adherence of grease or particles of sand or dirt. Bolts and nuts shall be tightened by opposites in order to keep flange faces square with each other, and to insure that bolt stresses are evenly distributed.
- F. Bolts and nuts in thrust restrained, mechanical and flanged joints shall be tightened in accordance with the recommendations of the pipe manufacturer for a leak-free joint. The mechanics shall exercise caution to prevent overstress. Torque wrenches shall be used until, in the opinion of the ENGINEER, the mechanics have become accustomed to the proper amount of pressure to apply on standard wrenches.
- G. Cutting of the ductile iron pipe for inserting valves, fittings, etc., shall be done by the Contractor in a neat and workmanlike manner without damage to the pipe, the lining, or the coating. Pipe 16 inches and larger in diameter shall be cut with a mechanical pipe saw. After cutting the pipe, the plain end shall be beveled with a heavy file or grinder to remove all sharp edges.
- H. Areas of loose or damaged lining associated with field cutting shall be repaired or replaced as recommended by the pipe manufacturer and required by the ENGINEER. Repair methods shall be as recommended by the manufacturer and shall be submitted to the ENGINEER for review.
- I. Any work within the pipe shall be performed with care to prevent damage to the lining. No cable, lifting arms or other devices shall be inserted into the pipe. All lifting, pulling or pushing mechanisms shall be applied to the exterior of the pipe barrel.

- J. Homing the pipe shall be accomplished by the use of a hydraulic or mechanical pulling device, unless otherwise accepted by the ENGINEER. No pipe shall be driven or struck in order to seat it home.
- K. Cleaning: Cleaning methods shall be acceptable to the ENGINEER, and must be sufficient to remove silt, rocks, or other debris which may have entered the pipeline during its installation and shall also follow the requirements of Section 15995, "Pipeline Testing and Disinfection".

- END OF SECTION -

SECTION 15020 - PIPE SUPPORTS

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall provide all tools, supplies, materials, equipment, and all labor necessary for the furnishing, construction, and installation of all pipe supports, hangers, guides, and anchors shown, specified, or required for a complete and operable piping system, in accordance with the requirements of the Contract Documents.
- B. Where pipe supports are specifically shown and/or detailed on the drawings, they shall supersede the requirements of this Section.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Piping, General
- B. Stainless Steel Pipe

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Commercial Standards:
 - ANSI / ASME B31.3 Process Piping
 - ANSI / ASME B31.1 Power Piping

1.04 CONTRACTOR SUBMITTALS

- A. Shop Drawings: The Contractor shall furnish complete shop drawings of all pipe supports, hangers, anchors, and guides, as well as calculations for special supports and anchors, in accordance with the Section entitled "Submittals".

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. The Contractor shall be responsible for the design of all piping support systems not specifically designed by the Engineer and detailed on the Drawings. The supports typically detailed on the Drawings, not included on Standard Detail Drawings, are designed to resist resulting external thrust forces in addition to gravity, seismic and other applicable loads required by the governing building code. Piping support systems shall be designed and Shop Drawings prepared and sealed by a Professional Engineer licensed in the State of Florida. Contractor designed supports shall be designed, furnished and installed at no additional cost to the Owner.
- B. The Contractor shall note that all pipe support locations are not shown on the Drawings and shall follow the Specifications herein in locating supports. Where deviations and modifications are required, they shall be made subject to review by the Engineer.
- C. Code Compliance: All piping systems and pipe connections to equipment shall be properly supported, to prevent undue deflection, vibration, and stresses on piping, equipment and structures. All supports and parts thereof shall conform to the requirements of ANSI/ASME B31.1 and ANSI / ASME B31.3, except as supplemented or modified by these Specifications. Supports for plumbing piping shall be in accordance with the latest edition of the applicable plumbing code, or local administration requirements.

- D. All piping shall be rigidly supported from the building structure by approved hangers, inserts, or supports. No piping shall be supported from other piping or from metal stairs, ladders, and walkways unless specifically permitted by the Engineer.
- E. Unless otherwise indicated on the Contract Drawings, piping supports shall consist of concrete piers or fabricated Type 316 Stainless Steel supports as specified below. Materials and workmanship shall be in full compliance with Division 3 - Concrete of these Specifications.
- F. Supporting appurtenances shall be arranged to prevent undue stress on equipment to which piping is connected. Supporting appurtenances shall provide the desired pitch as specified or required for proper drainage of the piping. The pipe suspension shall prevent excessive stress, excessive variation in supporting force, and possible resonance with imposed vibration while the system is in operation. All valves and valve operators shall be rigidly supported independently of the piping. Vertical runs of pipe shall be supported independently of the connected horizontal runs. All vertical pipes shall be supported at each floor or at intervals of at least 10 feet by approved pipe collars, clamps, brackets or wall rests. Supporting appurtenances, when used with copper piping, shall be copper, bronze or bronze plated. All piping shall be supported independently of the equipment to which it is connected. All in line devices (flowmeters, etc.) shall be removable without the need for temporary supports for adjacent and connecting piping.
- G. In general, the type of pipe supports to be used shall be as follows unless otherwise shown on the Drawings:

<u>Height of Centerline of Pipe above Floor</u>	<u>Type of Support</u>
3 feet or less	Concrete Pier
Greater than 6 feet	Adjustable Pipe Saddle, Bracket Supports or Hangers

- G. Wall bracket supports shall be used where shown for pipe to be installed adjacent to a wall. Where it is not feasible to install hanger supports, adjustable pipe saddle supports may be used upon review and acceptance by the Engineer. The Contractor shall install pipe supports in conformance with these Specifications unless otherwise shown on the Contract Drawings. Where deviations and modifications are required, they shall be made only with the permission of the Engineer. A detailed layout of pipe supports for each building shall be submitted to the Engineer for review prior to pipe fabrication or installation.
- H. For all couplings, supports shall be placed on each side and as close to the coupling as possible.
- I. Structural Members: Wherever possible, pipes shall be attached to structural members. Where it is necessary to frame structural members between existing members, such supplementary members shall be provided by the Contractor at no additional cost to the Owner. All supplementary members shall be in accordance with the requirements of the building code and the American Institute of Steel Construction. Stainless steel and non-metallic piping installed in tanks, channels or conduits shall be supported by hangers, hanger rods, hardware and inserts fabricated of Type 316 stainless steel.
- J. Freestanding pipe connections to equipment shall be firmly attached to fabricated Type 316 stainless steel frames made of angles, channels, or I-beams anchored to the

structure. Exterior, freestanding overhead piping shall be supported on fabricated Type 316 stainless steel pipe stands, consisting of pipe columns anchored to concrete footings, with horizontal, welded steel angles and U-bolts or clamps, securing the pipes. All materials shall be Type 316 stainless steel.

- K. Point Loads: Any meters, valves, heavy equipment, and other point loads on PVC, fiber glass, and other plastic pipes, shall be supported on both sides, according to manufacturer's recommendations to avoid undue pipe stresses and failures. To avoid point loads, all supports on plastic and fiber glass piping shall be equipped with extra wide pipe saddles or galvanized steel shields.
- L. Noise Reduction: To reduce transmission of noise in piping systems, all copper tubes in buildings and structures shall be wrapped with a 2-inch wide strip of rubber fabric or similar, suitable material, at each pipe support, bracket, clip, or hanger.
- M. Where a specific pipe support is called for on the Drawings, this support shall be used as and where indicated for the specific application. In general, spacing of supports shall be as specified herein unless specifically modified by the Engineer.
- N. All supports, saddles, bearing plates, and hangers, shall support by direct contact the pipe a minimum of 120 degrees around, except as specified herein.
- O. Where continuous concrete inserts are used, the maximum concentrated load on the end two (2) inches of inserts, with laying lengths of eight (8) inches or longer, shall not be more than 50 percent of the maximum recommended loading of the channel. All pipe supports shall be positioned such that they will not interfere with the use of hoisting equipment, where provided.
- P. Wherever expansion and contraction of piping is expected, a sufficient number of expansion loops or joints shall be provided, together with the necessary rolling or sliding supports, anchors, guides, pivots, and restraints. They shall permit the piping to expand and contract freely in directions away from the anchored points and shall be structurally suitable to withstand all loads imposed. Pipes subject to thermal expansion shall be installed perfectly aligned and concentrically guided. These piping support systems shall be submitted to the Engineer for review. The submittal shall show location of anchors, concentric pipe guides and expansion couplings (single or double).

2.02 TYPE 316 STAINLESS STEEL CHANNEL SUPPORTS

- A. Pipe supports shall be wall or slab mounted 1 5/8-inch X 1 5/8-inch UNISTRUT (or equal) Type 316 stainless steel channels with Type 316 stainless steel straps, and Type 316 stainless steel lock nuts. Supports shall be attached to walls and slabs by 3/8-inch diameter, 6-inch long Type 316 stainless steel anchor bolts with lock nuts. Bolt support spacing shall be maximum 12-inch O.C.

2.03 PIPE ROLLER SUPPORTS

- A. The Contractor shall furnish and install self-lubricating roller supports where shown on the Contract Drawings and as specified herein. Roller supports shall be Anvil Figure No. 271 or equal. Assemblies shall include all directly connected or welded anchorage hardware.
- B. Roller supports shall meet the loading requirements of the design and conforming to the details on the Drawings. The rollers shall have support section fabricated of the same material as is the pipe to be supported, a Type 316 series stainless steel slide plate, and a carbon steel base to which the Teflon is applied. The support plates at roller supports shall be stitch welded to stainless steel pipe at all roller support locations.

- C. The roller supports shall be installed in the exact locations shown or indicated on the Contract Drawings, at required elevations, true to orientation and level, assuring that the correct half of each roller is in its proper position. The Contractor shall store the rollers to protect them from mechanical damage prior to installation, and shall protect the same during and after installation from contamination and damage due to placing of concrete and other materials. The Contractor shall clean the operation surfaces of rollers thoroughly before final assembly.

2.04 SPRING TYPE HANGERS

- A. Spring-type pipe hangers shall be provided for piping subject to vibration or vertical expansion and contraction, such as engine exhausts and similar piping. All spring-type hangers shall be sized to the manufacturer's printed recommendations and the loading conditions encountered. Variable spring supports shall be provided with means to limit misalignment, buckling, eccentric loading, or to prevent overstressing of the spring, and with means to indicate at all times the compression of the spring. The support shall be designed for a maximum variation in supporting effort of 25 percent for the total travel resulting from thermal movement.

2.05 PIPE SUPPORT SPACING

- A. The distance between supports for each size of pipe shall not exceed those listed in the attached schedule. However, if the pipe size to be supported is not listed in the schedule, the next smaller nominal pipe size spacing shall be used. In all cases, there shall be a minimum of one support per laying length of pipe on uninterrupted horizontal runs. This support shall be placed within one (1) foot of the joint. If the pipe manufacturer recommends a smaller spacing interval than specified herein, then the manufacturer's spacing shall be used.
- B. The distance between supports shall not exceed that listed in the following schedule unless otherwise indicated on the Contract Drawings:

<u>Nominal Pipe Size (inches)</u>	<u>Metallic Piping (feet)</u>	<u>Plastic, Fiberglass and Copper Piping (feet)</u>
1/2	5	3
3/4 to 1-1/2	6	3
2 to 3	6	4
4	10	5
6 and larger	10	6

2.06 PIPE HANGERS AND HANGER RODS

- A. Where pipe hangers are used, they shall be of the clevis or friction clamp type except where there is longitudinal movement due to temperature changes. Where longitudinal movement occurs, the adjustable yoke roller type hanger shall be used. See the hanger schedule below for location/type of hangers to be used. Pipe hangers shall be capable of supporting the pipe in all conditions of operation. They shall allow free expansion and contraction of the piping, and prevent excessive stress resulting from transferred weight being induced into the pipe or connected equipment.
- B. All hangers shall have a means of vertical adjustment after erection. Hangers shall be designed so that they cannot become disengaged by any movement of the supported pipe. Hangers subject to shock, or thrust imposed by the actuation of safety valves, shall include hydraulic shock suppressors.
- C. Hangers shall be designed so that they can not become disengaged by movements of the supported pipe. Lock nuts shall be used on all hangers. All piping systems shall be supported by means of hangers having an individual means of vertical adjustment for leveling of lines after piping is in place.

- D. Spacing and arrangements shall conform to the requirements of Section 6, Chapter 1 of ANSI B31-1 code for pressure piping. Spacing indicated shall be the maximum spacing.
- E. Hanger rods shall be subject to tensile loading only. At hanger locations where lateral or axial movement is anticipated, suitable linkage shall be provided to permit swing. Stainless steel hangers required in the pipe hanger schedule shall be supported by hanger rods, hardware and inserts fabricated of Type 316 stainless steel.
- F. All other rods, hardware and inserts shall be fabricated of hot-dip galvanized steel. At hanger locations where lateral or axial movement is anticipated, suitable linkage shall be provided to permit such movement. Where horizontal pipe movement is greater than ½-inch, or where the hanger rod deflection from the vertical is greater than 4 degrees from the cold to the hot position of the pipe, the hanger rod and structural attachment shall be offset in such a manner that the rod is vertical in the hot position.
- G. All concrete inserts and/or expansion bolts shall be capable of supporting the maximum working load of the rod which is attached to it.
- H. Sheet metal insulation protector saddle shall be used for all hot water piping, refrigerant piping, etc.
- I. A neoprene isolation pad shall be provided between galvanized clevis and stainless steel piping. For hot air applications, a Teflon pad shall be provided.

2.07 SADDLES

- A. Pipe saddles shall be used to cradle horizontal piping when being supported from below except where expansion of pipe requires rollers. All saddles shall be capable of being adjusted after installation.

2.08 BASE ELBOWS, TEES AND CONCRETE PEDESTALS

- A. Base elbows, tees and concrete pedestals shall be provided at the locations shown on the Drawings and as specified. All vertical runs of pipe shall be supported on a base elbow and/or concrete pedestal. After completion of curing of the concrete pedestal, the piping shall be adjusted to the proper grade.

2.09 HARNESSSED PIPE SUPPORTS

- A. Pipe harness straps shall be provided on concrete pedestal supports where shown on the Drawings and required by these Specifications.
- B. Harness straps shall be 1/4-inch thick, Type 316 stainless steel and attached to the concrete pedestal supports by stainless steel anchors.
- C. Unless otherwise indicated on the Contract Drawings, strap width shall be in accordance with the Table below:

<u>Pipe Diameter</u>	<u>Strap Width</u>
4 inches and below	2 inches
6 inches and above	3 inches

2.10 METAL FRAMING SYSTEMS

- A. A metal framing system as manufactured by Unistrut, Globe-Strut or approved equal may be used for supporting the piping system. The metal framing system shall be designed

and installed according to manufacturer's recommended procedure and shall be capable of supporting the piping system as specified herein.

- B. Channels, inserts and closure strips shall be cold formed mild steel conforming to ASTM A-245.
- C. Fittings shall be Hot Rolled Steel conforming to ASTM A-307. Fasteners shall conform to ASTM A-307. All pieces shall be hot-dip galvanized after fabrication, unless otherwise noted on the Drawings.

2.11 PLASTIC PIPE SUPPORTS

- A. All pipe supports that will be used with plastic pipe shall be provided with a bearing plate where the width of hanger is less one-half ($\frac{1}{2}$) of the supported pipe's diameter. The bearing plate must provide bearing 180 degrees around and shall have a minimum laying length of $\frac{1}{2}$ the pipe diameter or three (3) inches minimum. The bearing plates shall be rigid, corrosion resistant and not subject to long term plastic flow properties. To assure one hundred (100) percent bearing, the pipe shall be seated on a filler. This material shall be compatible for use with the pipe. Clamps to be used with plastic pipe shall be fitted snug and shall not exert clamp pressure on the pipe.

2.12 THRUST RESTRAINT

- A. Pipe anchors shall be spaced to divide pipe into sections. Anchors shall be located at valves, changes in direction of piping, and major branch connections. Anchors shall be of a type recommended by the pipe manufacturer and reviewed by the Engineer.
- B. On all piping, where sleeve type couplings and flanged adapters are located near fittings or valves, tie rods shall span across the coupling as specified herein to restrain movements of the pipe along its axial direction. Such restraints can be deleted if both ends of the pipe are anchored in a concrete structure with no fitting or valve occurring within the span length, in the suction piping to a pump where the coupling is between the pump and valve, or when the water pressure measured at the crown of the pipe is less than five (5) feet.
- C. All sleeve type couplings shall be harnessed except where noted. The harnessing shall be as shown on the drawings or as specified herein. Harnesses for steel pipe shall be in accordance with AWWA Manual M11 for the pipe size and pressure, working or test whichever is greater.
- D. Harnesses shall be tie rods spanning between adjacent flanges. Friction clamps shall not be permitted. The size and number of tie rods shall be the same as for steel pipe for the same pressure and pipe size.
- E. Where the distance between adjacent flanges is in excess of ten (10) feet or where a harness can not be used, the pipe supports adjacent to the coupling shall restrain the piping preventing any linear or angular movement resulting in the pipe separating from the coupling or misalignment in the joint.
- F. Where expansion joints are used, control units shall be provided. All tie rods and control units shall be installed in accordance with the manufacturer's recommended procedures.
- G. Tie rods and associated hardware shall be Type 316 stainless steel.
- H. In general, all valves and fittings shall be restrained in an approved manner such that the unbalanced force developed at them shall be supported independent of the piping system.

2.13 MANUFACTURED SUPPORTS

- A. Stock Parts: Where not specifically shown or detailed, designs, generally accepted as exemplifying good engineering practice, using stock or production parts, shall be utilized wherever possible. Such parts shall be locally available, new, of best commercial quality, designed and rated for the intended purpose.
- B. Suppliers or equal:
 - 1. Basic Engineers, Pittsburgh, PA;
 - 2. Bergen-Paterson Corp., Boston, MA;
 - 3. Elcen Metal Products Company, Franklin Park, IL;
 - 4. Anvil International, Inc., Portsmouth, NH;
 - 5. NPS Industries, Inc., Secaucus, NJ;
 - 6. Unistrut Corp., Itasca, IL.

2.14 COATING

- A. Galvanizing: All fabricated pipe supports, other than stainless steel or non-ferrous supports, shall be blast cleaned after fabrication and hot-dip galvanized in accordance with ASTM A123.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. General: All pipe supports, hangers, brackets, anchors, guides, and inserts shall be fabricated and installed in accordance with the manufacturer's printed instructions and ANSI/ASME B31.1 and ANSI / ASME B31.3. All concrete inserts for pipe hangers and supports shall be coordinated with the formwork.
- B. Appearance: Pipe supports and hangers shall be positioned in such a way as to produce an orderly, neat piping system. All hanger rods shall be vertical, without offsets. Hangers shall be adjusted to line up groups of pipes at the proper grade for drainage and venting, as close to ceilings or roofs as possible, without interference with other Work.
- C. Pipe Support Spacing: The distance between supports for each size of pipe shall not exceed those specified in 2.05.

3.02 FABRICATION

- A. Quality Control: Pipe hangers and supports shall be fabricated and installed by experienced welders and fitters, using the best welding procedures available. Welding shall conform to the Section entitled "Metal Fabrications". Fabricated supports shall be neat in appearance without sharp corners, burrs, and edges.

- END OF SECTION -

SECTION 15106 - BALL VALVES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall furnish and install ball valves, complete and operable, as shown and specified herein, including epoxy coating, appurtenances, operators, and accessories, all in accordance with the requirements of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Submittals
- B. Painting

1.03 SUBMITTALS

- A. Shop Drawings: Submit shop drawings in accordance with the section entitled "Submittals." The shop drawings shall include the following:
 - 1. Manufacturer's standard literature.
 - 2. Dimension drawings for all valves to be supplied.
 - 3. Valve manufacture's recommended instructions for joining the valves and piping.
- B. Operation and Maintenance Manuals: Submit shop drawings in accordance with the section entitled "Submittals." The shop drawings shall include the following:
 - 1. Manufacturer's standard literature.
 - 2. Dimension drawings for all valves to be supplied.
 - 3. Valve manufacture's recommended instructions for joining the valves and piping.

PART 2 -- PRODUCTS

2.01 STAINLESS STEEL BALL VALVES

- A. Materials: Ball valves for use with stainless steel piping systems, including instrument isolation, air lines, and moisture drains and at all other locations shown on the drawings shall be 316 stainless steel body and trim.
- A. Body Type: two or three piece design
- B. Ends: flanged or threaded connections as required.

- C. Seats and seals: Teflon
- D. Ball: no internal ring for the ball shall be acceptable
- E. Class: 150
- G. Manually operated valves of 4-inch size and larger shall have right-angle gear type operators with handwheel. Manually operated valves of 2-inch size and larger that require proximity position switches shall have right-angle gear operators except that such valves may have lever operators through 3-inch size where the valve manufacturer offers compatible valve, operator and proximity switch units. The mounting of right-angle gear operators shall conform to ISO 5211.
- H. Manufacturers:
 - 1. 'Apollo' Valves manufactured by Conbraco Industries, Inc.
 - 2. NIBCO
 - 3. Valen, Inc.
 - 4. FNW Valve (Ferguson Enterprises, Inc.)
 - 5. Jamesbury Corporation

PART 3 -- EXECUTION

3.01 GENERAL

- A. All valves shall be installed in accordance with provisions of section entitled "Valves and Appurtenances". Care shall be taken that all valves in plastic lines are well supported on each end of the valve.
- B. All valves shall be tested for unidirectional or bi-directional shut-off as required by service conditions.

- END OF SECTION -

SECTION 15108 - GATE VALVES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Reference Section 15000, Basic Mechanical Requirements.

PART 2 -- PRODUCTS

2.01 GATE VALVES

- A. General: All valves, unless otherwise specified, shall be the product of one manufacturer.
- B. Gate Valves up to 12-inch Diameter: Comply with AWWA C515, titled "Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service".
- C. Gate Valves up to 14-inch Diameter and Larger: Comply with AWWA C515, titled "Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service".
- D. Stem Material: Manufacturer's standard.
- E. Stem Style:
1. All above-ground valves shall be non-rising-stem type.
 2. All below-ground valves shall be non-rising-stem type
- F. Gaskets and O-Rings: EPDM, no substitution.
- G. Standards: Valves shall be certified to the following:
1. NSF/ANSI 61 titled "Drinking Water System Components – Health Effects"
 2. NSF/ANSI 372 titled "Drinking Water System Components – Lead Content"
- H. Operating Nuts: Operating nuts shall be AWWA 2-inch square with skirts and open by turning the nut counter clockwise.
- I. Bevel Gear: Gate valves shall be suitable for horizontal installation for buried service, where needed for clearance and at locations indicated on the Drawings. Provide bevel gear for horizontal installation.
- J. Buried Service Ends: Unless indicated otherwise on the Drawings, buried service valves shall have mechanical joint ends.
- K. Above Grade Service Ends: Unless indicated otherwise on the Drawings, above ground valves shall have flanged joints. Flanges shall be Class 125 per ANSI/ASME B16.1 or Class 150 per ANSI/ASME B16.5.

L. Factory Applied Coatings for Water Service Valves:

1. Valve interior and exterior shall have a fusion-bonded epoxy coating that is applied prior to assembly.
2. The bolt holes and body-to-bonnet flange surfaces shall be fully epoxy coated.
3. Coatings shall comply with NSF/ANSI Standard 61, titled "Drinking Water System Components – Health Effects".
4. Coatings shall comply with ANSI/AWWA C550, titled "Protective Interior coatings for Valves and Hydrants".
5. Factory applied exterior coating shall be compatible with the final coating system specified in Section titled "Painting".

M. Manufacturer, or Equal:

1. American Cast Iron Pipe Company
2. Mueller
3. American AVK Company

PART 3 -- EXECUTION

3.01 GENERAL

- A. All valves shall be installed in accordance with provisions of Section entitled "Valves, General".
- B. Above ground valves shall be oriented to ensure that the valve operator is easily accessible by a person standing at grade.
- C. Field Coatings: All valve exteriors shall be painted as specified in the Section titled "Painting".

- END OF SECTION -

SECTION 15114 - MISCELLANEOUS VALVES AND APPURTENANCES

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall furnish and install miscellaneous valves as shown and as specified herein, complete and operable including protective coatings, appurtenant work and operators, all in accordance with the requirements of the Contract Documents.

1.02 SUBMITTALS

- A. Submit shop drawings and Operation and Maintenance Manual all in accordance with the Sections entitled "Submittals" and "Equipment, General".

1.03 TOOLS, SUPPLIES AND SPARE PARTS

- A. The CONTRACTOR shall furnish one spare unit of each type and size of valve supplied in this section.

PART 2 – PRODUCTS

2.01 AIR RELEASE VALVES FOR WATER SERVICE

- A. Automatic air release valves shall be designed to operate under a test pressure of 150 psi, and allow trapped air to escape from a pipeline, pump tank or liquid system. After the air escapes out of the air release valve through the orifice the valve shall close to prevent water from escaping. The air release valve will then stay closed until more air accumulates in it and the opening cycles will be repeated automatically. The air release valve shall have a stainless-steel float.
- B. Manufacturers, or Equal: 1-inch inlet, Val-Matic Model 25.5 with 1/8-inch orifice.

2.02 WELL SERVICE AIR VALVES

- A. All can type vertical turbine pumps and raw water well pumps shall be equipped with well service air valves on the discharge outlet. Well service air valves shall be fully automatic float operated valves designed to exhaust air which is present in the pump column on pump startup and allow air to re-enter the column on pump shutdown or should a negative pressure occur. The valve supplier shall be responsible for sizing the well service air valves based upon the hydraulic characteristics of the pumps supplied based upon approved pump shop drawings. The valve supplier shall submit their calculations (along with sizing criteria) with the well service air valve shop drawing submittal.
- B. Manufacturers, or Equal: Val-Matic Model 102ST.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. All couplings and caps shall be installed in accordance with the manufacturer's recommendations and the requirements of the Section entitled "Valves, General".

– END OF SECTION –

SECTION 15215 – FLOW LIMITING VALVES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Where shown on the Drawings furnish and install flow limiting (rate of flow) control valves including all appurtenances, complete and operable, in accordance with the Contract Documents.
- B. This product will be used in drinking water. Materials in contact with potable water must comply with the lead-free requirements of the Safe Drinking Water Act.

1.02 SUBMITTALS

- A. The CONTRACTOR shall furnish submittals in accordance with Section entitled "Submittals".

PART 2 -- PRODUCTS

2.01 GENERAL

- A. The flow limiting valve shall be located on the discharge of raw water supply pump.
- B. The flow limiting valve shall be a pilot operated flow control valve that will limit flow rate to a preset maximum. The valve shall be normally open and will limit the maximum flow rate by differential pressure control across a downstream orifice plate, regardless of fluctuations in upstream or downstream pressure.
- C. The maximum flowrate shall be adjustable via the pilot controls.
- D. The valve shall be equipped with an internal drop check (IDC) that closes to seal against reverse flow, regardless of valve position.
- E. The valve shall be operated hydraulically via the pilot controls. Valves controlled with solenoid switches or electrically powered adjustment modules are not acceptable.

2.02 QUALITY ASSURANCE

- A. The control valve shall be tested prior to shipment. The standard test shall include a functional stroke test and pressure and leak test of valve body, seat, fitted pilots and accessories.
- B. The control valve shall be covered by a minimum three (3) year warranty against defects in materials and workmanship.
- C. All control valve maintenance and repairs shall be possible without removing the main valve body from the line, when installed in accordance with manufacturer's recommendations.

2.03 CERTIFICATION REQUIREMENTS

- A. The manufacturer shall submit documentation with the shop drawing that certifies that all wetted components shall be “lead-free” in accordance with the Safe Drinking Water Act and comply with NSF-61 and NSF-372. The manufacturer shall certify that its materials selection complies with these requirements.
- B. The manufacturer shall submit documentation with the shop drawing that certifies that coatings in contact with potable water comply with NSF-61.

2.04 DESIGN BASIS

- A. This specification is based on Singer Valve main valve model S206-PG and Singer Model 160-RF Rate of Flow Pilot.
- B. Equal products of other manufacturers will be considered.

2.05 MAIN VALVE

- A. Nominal Diameter: as indicated on the Drawings
- B. Style: Globe type diaphragm actuated
- C. Chambers: Single chamber
- D. Port Type: Reduced port (model S206 by Singer Valve, or Equal)
- E. Manufacturer, or Equal:
 - 1. Singer Valve model: S206-PG
 - 2. Watts (Ames Fire and Waterworks brand)
- F. Materials:
 - 1. Main Valve Body and Cover: Provide manufacturer’s standard ductile iron materials.
 - 2. Main Valve Trim: Materials in contact with potable water shall be “lead-free” as defined by the Safe Drinking Water Act. The manufacturer shall certify that its materials selection complies.
 - 3. Elastomers: Diaphragm, resilient disc and seals, shall be of EPDM.
 - 4. Fasteners (bolts, nuts, studs, cap screws): AISI 18-8 or 304 stainless steel or 316 stainless steel.
- G. Stem Cap: Stem cap shall be removable for access to the main valve stem for alignment check, spring installation and ease of service and assembly.

- H. Coatings: All internal and external ferrous components, including all mating surfaces, shall be coated with an NSF-61 approved fusion bonded epoxy to a minimum of 10-mils dry film thickness.
- I. End Connections: Ends shall be flanged and meet the requirements of ANSI/ASME B16.42 Class 150.
- J. Cavitation Control Trim: The valve shall be supplied cavitation control trim if determined necessary by the manufacturer. Cavitation control trim shall be designed by the valve manufacturer to be optimized to the actual operating parameters of the control valve application and warranted to perform correctly and prevent main valve cavitation damage under the stated conditions.

2.06 PILOT CONTROLS

- A. Operation: The pilot shall be a normally open Singer Model 160-RF Rate of Flow Pilot (or equivalent of the main valve manufacturers specified in Article 2.05) that reacts to small changes in differential pressure across a downstream orifice plate, which acts to modulate the main valve bonnet pressure to hydraulically adjust the inner valve assembly position to maintain a maximum flow rate as a function of the orifice plate bore and differential pressure control setting.
- B. The rate of flow control pilot shall include a field adjustable spring to adjust the differential pressure setting.
- C. Materials:
 - 1. The pilot trim, consisting of a seat ring, stem and yoke shall be constructed of 316 stainless steel.
 - 2. The pilot elastomers: diaphragm, inner valve and seals, shall be EPDM.
 - 3. The pilot body and spring casing shall be constructed of ASTM A351 CF8M stainless steel.
 - 4. The pilot fittings shall be AISI 316 stainless steel.
 - 5. The pilot tubing shall be AISI 316 stainless steel.
 - 6. Materials for other items shall be as indicated below.
- D. Pilot Spring Range: The adjustable pilot spring range shall be 2 to 20-psid.
- E. Pilot Spring Factory Setpoint: The pilot spring shall be preset at the factory at a pressure differential suitable to provide a maximum flow rate setpoint of 2,200-gpm.
- F. Orifice Plate Design Criteria: The supplied orifice plate shall be of 11 Ga. (0.120in) AISI 18-8 stainless steel. The machined orifice bore, to a +/- 0.005in tolerance, shall provide a 2:1 adjustable flow ratio of 1,100-gpm to 2,200 gpm over 3 to 12-psid adjustment of the pilot.
- G. Orifice Bore Calculations: Orifice bore calculations shall be provided by the manufacturer.

- H. Orifice Plate: A paddle style orifice plate shall be provided to fit between and within the bolt circle and fasteners of the specified flange rating. The orifice bore shall be engraved on the paddle portion and visible with the orifice plate installed.
- I. A fixed restriction shall be supplied as AISI 303 stainless steel with an orifice bore selected by the manufacturer based on the valve size and operation.
- J. Closing Speed Control: An adjustable needle valve closing speed control shall be supplied as AISI 316 stainless steel.
- K. Opening Speed Control: The adjustable flow stabilizer shall be a Singer Model 26 (or equivalent of the main valve manufacturers specified in Article 2.05) self-cleaning opening speed control, supplied as a stainless-steel assembly.
- L. Isolation Valves: Three (3) pilot isolation ball valves shall be supplied. Pilot isolation ball valves shall be 316 stainless steel with stainless steel handle operator.
- M. Strainer: A pilot strainer shall be supplied. Strainer material to be ASTM A351 CF8M stainless steel with a 40-mesh 316 stainless steel screen. The external pilot strainer shall have a removable plug for easy maintenance access to the pilot screen and have provision for installation of a ball valve for pilot screen flushing.
- N. Position Indicator: The control valve shall be supplied with a Singer Model X107 Position Indicator (or equivalent of the main valve manufacturers specified in Article 2.05). The valve position indicator shall provide a visual reference to the main valve open position. The indicator stem rod shall be AISI 316 stainless steel, threaded or pinned to the main valve stem. The indicator rod shall move within a 303 stainless steel hexagonal housing having a clear Pyrex sight glass. A cap and bleed valve shall be provided to purge any air that may become trapped within the main valve bonnet and stem cap.

2.07 INTERNAL DROP CHECK

- A. Main valve shall include an internal drop check (IDC).
- B. If forward flow stops for any reason, the IDC shall close to seal against reverse flow, regardless of the main valve position.
- C. The IDC shall incorporate the main valve stem only. No secondary valve stems will be permitted.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. Valves shall be installed in accordance with valve manufacturer's instructions.

3.02 SERVICES OF MANUFACTURERS

- A. Inspection, Startup, and Field Adjustment: The service representative of the valve Manufacturer shall be present at the site for one workday, to assist the CONTRACTOR in the installation and adjustment of the valve(s).
- B. Instruction of OWNER'S Personnel: The training representative of the valve Manufacturer shall be present at the site for one workday to instruct the personnel in the operation, adjustment, and maintenance of the valve(s).
- C. For the purpose of this paragraph, a workday is defined as an eight-hour period, excluding travel time.

- END OF SECTION -

SECTION 15218 - RELIEF VALVES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Where shown on the Drawings provide pressure relief valves including all appurtenances, complete and operable, in accordance with the Contract Documents.

1.02 SUBMITTALS

- A. The CONTRACTOR shall furnish submittals in accordance with Section entitled "Submittals".

PART 2 -- PRODUCTS

2.01 PRESSURE RELIEF VALVES

- A. Type: Angle type diaphragm valve with hydraulically operated, adjustable, pilot controls.
- B. General: Valve shall open when the inlet pressure exceeds a set maximum level. It shall close as the inlet pressure drops below the maximum pressure.
- C. Chambers: The main valve shall be either single or dual chamber as recommended by the manufacturer.
- D. Ends: Main valve shall have fended end connections. Flanges shall be ANSI/ASME B16.42 Class 150 pound.
- E. Coatings: The interior and exterior of the main valve body shall be coated with NSF 61 certified fusion bonded epoxy 8-mils DFT minimum.
- F. Options: Supply with position indicator on the main valve.
- G. Main Valve Trim: The valve stems, springs, body seat rings, and all bolts, nuts, and washers shall be stainless steel.
- H. Pilot Materials: Pilot fittings, tubing, speed controls, valves and accessories shall be 316 stainless steel.
- I. Elastomers: The main valve and pilot elastomers shall be of EPDM.
- J. Operating Conditions: Wellhead pressure relief valves shall be designed to operate under the following conditions:
 - 1. Maximum flow through valve (gpm): 2,000
 - 2. Valve inlet pressure (psi): 80 to 95
 - 3. Valve relieves to: Atmosphere

4. Body type: angle
 5. Valve size (inches): 6
 6. Relief pilot initial setting: Main valve shall open to relieve pressure at 110 psi
- K. Spare Parts: The following spare parts shall be furnished for each valve:
1. 1 set of all resilient seals, and discs
 2. 1 strainer
 3. 1 diaphragm for the pilot valve
- L. Manufacturers:
1. Bermad Automatic Control Valves
 2. Singer Valve (a Mueller Brand)
 3. Ross Valve Mfg. Co., Inc.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. All valves shall be installed in accordance with provisions set forth in Section 15100 – Valves and Appurtenances.

3.02 SERVICES OF MANUFACTURER

- A. Inspection, Startup, and Field Adjustment: The service representative of the valve Manufacturer shall be present at the site for one workday, to assist the CONTRACTOR in the installation and adjustment of the valve(s).
- B. Instruction of OWNER'S Personnel: The training representative of the valve Manufacturer shall be present at the site for one workday to instruct the personnel in the operation, adjustment, and maintenance of the valve(s).
- C. For the purpose of this paragraph, a workday is defined as an eight-hour period, excluding travel time.

- END OF SECTION -

SECTION 15995 - PIPELINE TESTING AND DISINFECTION

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall perform flushing and testing of all pipelines and appurtenant piping, complete, including conveyance of test water from OWNER designated source to point of use and all disposal thereof, all in accordance with the requirements of the Contract Documents.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Commercial Standards
 - 1. ANSI/AWWA B300 Hypochlorites
 - 2. ANSI/AWWA B301 Liquid Chlorine
 - 3. ANSI/AWWA C600 Installation of Ductile Iron Water Mains and their Appurtenances
 - 4. ANSI/AWWA C651 Disinfecting Water Mains

1.03 SUBMITTALS

- A. The CONTRACTOR shall submit disinfection test reports and hydrostatic test reports in accordance with the Section titled "Submittals".

PART 2 -- PRODUCTS

2.01 MATERIALS REQUIREMENTS

- A. All test equipment, temporary piping, temporary valves or bulkheads, or other water control equipment and materials shall be determined and furnished by the CONTRACTOR subject to the ENGINEER's review. No materials shall be used which would be injurious to the water in the clearwell the construction or its future function.

PART 3 -- EXECUTION

3.01 GENERAL

- A. Notify the ENGINEER and OWNER 48 hours in advance to obtain OWNER's approval to commence testing and/or disinfection of any particular structure and/or pipeline.
- B. Unless otherwise provided herein, water for testing pipelines will be from an OWNER furnished source; however, the CONTRACTOR shall make all necessary provisions for conveying the water from the OWNER-designated source to the points of use and for the cost of such water as discussed in Division 1 of these specifications.

- C. All pressure and gravity pipelines shall be tested. All testing operations shall be performed in the presence of the ENGINEER.

3.02 TESTING OF PIPELINES

- A. All equipment, including, but not limited to, pumps, gauges, and special fittings required to perform the testing shall be provided by the Contractor. The Contractor shall perform all excavation and other work required to locate and repair leaks and correct other defects which may be disclosed or develop under tests. The Contractor shall replace all coating, painting, backfill, or other permanent work removed in locating or repairing leaks and correcting defective piping. All gauges and control devices connected to lines being tested must be disconnected for the duration of the test. Water shall not be used in testing air lines, chlorine gas lines, or other gas carrying pipes. All tests shall be witnessed by the Engineer.
- B. Prior to hydrostatic testing, all pipelines shall be flushed or blown out as appropriate. The CONTRACTOR shall test all pipelines either in sections or as a unit. No section of the pipeline shall be tested until all field-placed concrete or mortar have attained an age of fourteen days. The test shall be made by closing valves when available, or by placing temporary bulkheads in the pipe and filling the line slowly with water. The CONTRACTOR shall be responsible for ascertaining that all test bulkheads are suitably restrained to resist the thrust of the test pressure without damage to, or movement of, the adjacent pipe. Care shall be taken to see that all air vents are open during filling.
- C. The pipeline shall be filled at a rate which will not cause any surges or exceed the rate at which the air can be released through the air valves at a reasonable velocity and all the air within the pipeline shall be properly purged. After the pipeline or section thereof has been filled, it shall be allowed to stand under a slight pressure for at least twenty-four hours to allow the concrete or mortar lining, as applicable, to absorb water it will -and to allow the escape of air from any air pockets. During this period, bulkheads, valves, and connections shall be examined for leaks. If leaks are found, corrective measures satisfactory to the ENGINEER shall be taken.
- D. The hydrostatic test shall consist of holding the test pressure on the pipeline for a period of four hours. The test pressure for pipelines shall be 150 psi. Test pressure shall be measured at the lowest point of the pipeline section being tested. All visible leaks shall be repaired in a manner acceptable to the ENGINEER. No visible leaks will be allowed.
- E. Gravity sewer pipe or other pipe having free surface flow shall be given a water exfiltration test as specified herein. The Contractor has the option of using a low pressure air test in lieu of the water exfiltration test. If excessive groundwater is present which precludes use of the exfiltration test, the Contractor shall use either the low pressure air test or infiltration test.
- F. Leakage Tests: Leakage tests shall be conducted concurrently with the pressure test. The allowable leakage shall be determined in accordance with AWWA C600. The duration of the test shall be not less than two hours. Measurement shall be made by means of a calibrated suction tank showing the amount of water required by the test pump to accurately maintain the specified test pressure. Tests shall be performed only in the presence of the Engineer, or, if scheduling of tests is such that the Engineer cannot

attend due to conflicting commitment, tests may be performed without the Engineer's presence if the Contractor obtains written permission to do so from the Engineer prior to initiation of testing. No test report will be accepted unless proof of compliance with the foregoing requirement accompanies the test report.

- G. In the case of pipelines that fail to pass the prescribed leakage test, the Contractor shall determine the cause of the leakage, shall take corrective measures necessary to repair the leaks, and shall repeat the test until the testing requirements are met.

3.03 FLUSHING

- A. All piping shall be flushed clean of all dirt and foreign material following completion of the hydrostatic and leakage test. Air and gas piping shall be purged with air or nitrogen gas as directed by the Engineer.
- B. Equipment and Supplies. The Contractor shall provide all equipment, and supplies for performing the work, and shall waste the water at locations or by procedures approved by the Engineer.

3.04 DISINFECTION

- A. Disinfection of potable water lines shall be performed in accordance with AWWA Standard C-651, State of Florida and local applicable regulations. The Contractor shall be responsible for furnishing fittings and all special pipe taps required by the pipe disinfection work.
- B. Inject the required amount of disinfectant to yield a minimum chlorine content of 50 ppm into piping system.
- C. Allow solution to remain in the pipes for twenty-four hours or longer, if required, to destroy all harmful bacteria.
- D. Operate all valves and other appurtenances during disinfection to assure the sterilizing mixture is dispersed into all parts of the system.
- E. After the solution has been retained for the required time, pipes shall be flushed and filled with municipal domestic water. Sterilizing water shall be disposed of in an approved manner. Sterilizing water shall not be allowed to flow into a waterway without reducing chlorine concentrations to a safe level. The CONTRACTOR shall be responsible for meeting all applicable requirements and acquiring all necessary permits for this work.
- F. Take one bacteriological sample and test from every segment of pipeline tested. Samples shall be taken and tested on each of two successive days. CONTRACTOR shall submit sample to a laboratory, approved by ENGINEER, for testing. The disinfection process shall be repeated if laboratory test results reflects presence of harmful bacteria in the water.

3.05 TESTS

- A. Regulatory Requirements:

1. Conform to Chapter 62-555 of the Florida Administrative Code.
 2. Conform to FDEP Standard Operating Procedures for Field Activities (DEP-SOP-001/01).
- B. Testing for Chlorine prior to Flushing: Prior to flushing the chlorinated water from the pipeline coordinate with the OWNER's laboratory to take samples and test for chlorine residual. After 48 hours, if chlorine solution contains at least 25 parts per million of chlorine, the line may then be flushed. If less than 25 parts per million of chlorine is found then the pipeline must be re-disinfected.
- D. Bacteriological Evaluation of Pipeline: After flushing the chlorinated water from the pipeline (to less than the maximum allowable per Chapter 62-555 Florida Administrative Code) coordinate with the CONTRACTOR's laboratory to take samples and perform bacteriological evaluation as follows:
1. Laboratory shall follow appropriate procedures in the Department of Environmental Protection Standard Operating Procedures for Field Activities, DEP-SOP-001/01, as incorporated into Rule 62-160.800 Florida Administrative Code.
 2. After reducing the total chlorine residual in the facilities or mains to no more than four milligrams per liter, a total of at least two samples – each taken on a separate day and taken at least six hours apart from the other sample(s) – shall be collected at each of the locations indicated in the applicable AWWA standard C651, and the samples shall be analyzed for total residual chlorine and for the presence of total coliform
 3. If any sample contains more than four milligrams per liter of total chlorine, the sample shall be considered invalid. If any sample shows the presence of total coliform, the facilities or mains shall be re-disinfected as necessary in accordance with AWWA standard C651, and resampled until two consecutive samples at each sampling location show the absence of total coliform.
- E. Florida Department of Environmental Protection Clearance: New piping cannot be placed into service until clearance is received from the Florida Department of Environmental Protection.
- F. Test Reports: Submit bacteriological test reports and leakage test reports to the Engineer. The Engineer will submit to the documentation to the Florida Department of Environmental Protection for approval to put the pipeline into service.
- 3.06 CONNECTIONS TO EXISTING SYSTEM
- A. Where connections are to be made to an existing potable water system, the interior surfaces of all pipe and fittings used in making the connections shall be swabbed or sprayed with a five percent sodium hypochlorite solution before they are installed. Thorough flushing shall be started as soon as the connection is completed and shall be continued until discolored water is eliminated.
- B. Prior to actual connections to the existing potable water system, record drawings, hydrostatic pressure test results, and bacterial test results shall be submitted to the

Engineer. Upon approval from the Broward County Department of Public Health, the connection can be constructed.

- C. Connections to the existing system shall be performed in the presence of the OWNER.

- END OF SECTION -

SECTION 16000 - BASIC ELECTRICAL REQUIREMENTS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish all labor, materials, tools, and equipment, and perform all work and services necessary for, or incidental, to the furnishing and installation of all electrical work as shown on the Drawings, and as specified in accordance with the provisions of the Contract Documents and completely coordinate with the work of other trades involved in the general construction. Although such work is not specifically shown or specified, all supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a sound, secure, and complete installation shall be furnished and installed as part of this work. The Contractor shall obtain approved Shop Drawings showing wiring diagrams, connection diagrams, roughing-in and hook up details for all equipment and comply therewith. All electrical work shall be complete and left in operating condition in accordance with the intent of the Drawings and the Specifications for the electrical work.
- B. Reference Section entitled "Control and Information System, General" for scope of work details as they relate to the Division 17 Subcontractor.
- C. The electrical scope of work for this project primarily includes, but is not limited to, the following:
 - 1. Furnish and install pump control panel, transfer switch, dry-type transformers, and other low voltage electrical power distribution equipment.
 - 2. Furnish and install all aboveground raceway systems including conduit, fittings, boxes, supports, and other pertinent components.
 - 3. Furnish and install all underground raceway systems including conduit, fittings, manholes, handholes and other pertinent components.
 - 4. Furnish and install all low and medium voltage wire and cable resulting in a complete and operable electrical system.
 - 5. Furnish and install new lighting systems and wiring devices.
 - 6. Other electrical work as specified herein and indicated on the Drawings.
- D. All material and equipment must be the product of an established, reputable, and approved manufacturer; must be new and of first class construction; must be designed and guaranteed to perform the service required; and must bear the label of approval of the Underwriters Laboratories, Inc., where such approval is available for the product of the listed manufacturer as approved by the Engineer.

- E. When a specified or indicated item has been superseded or is no longer available, the manufacturer's latest equivalent type or model of material or equipment as approved by the Engineer shall be furnished and installed at no additional cost to the Owner.
- F. Where the Contractor's selection of equipment of specified manufacturers or additionally approved manufacturers requires changes or additions to the system design, the Contractor shall be responsible in all respects for the modifications to all system designs, subject to approval of the Engineer. The Contractor's bid shall include all costs for all work of the Contract for all trades made necessary by such changes, additions or modifications or resulting from any approved substitution.
- G. Furnish and install all stands, racks, brackets, supports, and similar equipment required to properly serve the equipment which is furnished under this Contract, or equipment otherwise specified or indicated on the Drawings.

1.02 EQUIPMENT LOCATION

- A. The Drawings show the general location of feeders, transformers, outlets, conduits, and circuit arrangements. Because of the small scale of the Drawings, it is not possible to indicate all of the details involved. The Contractor shall carefully investigate the structural and finish conditions affecting all of his work and shall arrange such work accordingly; furnishing such fittings, junction boxes, and accessories as may be required to meet such conditions. The Contractor shall refer to the entire Drawing set to verify openings, special surfaces, and location of other equipment, or other special equipment prior to roughing-in for panels, switches, and other outlets. The Contractor shall verify all equipment dimensions to ensure that proposed equipment will fit properly in spaces indicated.
- B. Where outlets are shown near identified equipment furnished by this or other Contractors, it is the intent of the Specifications and Drawings that the outlet be located at the equipment to be served. The Contractor shall coordinate the location of these outlets to be near the final location of the equipment served whether placed correctly or incorrectly on the Drawings.

1.03 LOCAL CONDITIONS

- A. The Contractor shall examine the site and become familiar with conditions affecting the work. The Contractor shall investigate, determine, and verify locations of any overhead or buried utilities on or near the site, and shall determine such locations in conjunction with all public and/or private utility companies and with all authorities having jurisdiction. All costs, both temporary and permanent to connect all utilities, shall be included in the Bid. The Contractor shall be responsible for scheduling and coordinating with the local utility for temporary and permanent services.
- B. The Contractor is responsible for coordinating all electric utility equipment installations with the serving electric utility. The Contractor shall furnish and install all electric utility equipment required by the electric utility to be installed by the Contractor whether specifically shown on the Drawings or not. The Contractor shall furnish and install the following electrical utility equipment as a minimum:
 - 1. Trench, conduit, and cables for new service.
 - 2. Meter socket and mounting rack.

3. Utility meter grounding.

The electric utility will furnish and install the following equipment:

1. Utility meter.
2. Handhole at base of pole for connecting service conductors to FPL service conductors. Connection shall be performed by FPL.

The Contractor is responsible for ensuring all electric utility equipment and construction installed by the Contractor is furnished and installed in accordance with the electric utility's design specifications and requirements. The Contractor is fully responsible for coordinating his scope of work with the electric utility. Any additional required electric utility construction or equipment not specified herein or shown on the Drawings shall be supplied by the Contractor at no additional cost to the Owner.

The contact person(s) at the serving electrical utility are:

Nancy Diaz-Quinones
Florida Power and Light
Gulfstream Service Center
4000 Davie Road Extension
Hollywood, FL 33024
Tel: (954)-442-6337
Email: nancy.diaz-quinones@fpl.com

Lenin Vargas
Hallandale Beach WTP FPL Tech Rep
Gulfstream Service Center
4000 Davie Road Extension, Hollywood, 33024
Email: lenin.vargas@fpl.com
Phone: (954) 442-6362
Mobile: (305) 987-4926

1.04 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions, Section entitled "Submittals" and the requirements of the individual specification sections, the Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings
2. Operation and Maintenance Manuals
3. Spare Parts List
4. Proposed Testing Methods and Reports of Certified Shop Tests.
5. Reports of Certified Field Tests.
6. Manufacturer's Representative's Certification.

- B. Submittals shall be sufficiently complete in detail to enable the Engineer to determine compliance with Contract requirements. All submittals furnished in electronic format shall be machine readable.
- C. Submittals will be approved only to the extent of the information shown. Approval of an item of equipment shall not be construed to mean approval for components of that item for which the Contractor has provided no information.
- D. Some individual Division 16 specification sections may require a Compliance, Deviations, and Exceptions (CD&E) letter to be submitted. If the CD&E letter is required and shop drawings are submitted without the letter, the submittal will be rejected. The letter shall include all comments, deviations and exceptions taken to the Drawings and Specifications by the Contractor AND Equipment Manufacturer/Supplier. This letter shall include a copy of this specification section. In the left margin beside each and every paragraph/item, a letter "C", "D", or "E" shall be typed or written in. The letter "C" shall be for full compliance with the requirement. The letter "D" shall be for a deviation from the requirement. The letter "E" shall be for taking exception to a requirement. Any requirements with the letter "D" or "E" beside them shall be provided with a full typewritten explanation of the deviation/exception. Handwritten explanation of the deviations/exceptions is not acceptable. The CD&E letter shall also address deviations, and exceptions taken to each Drawing related to this Specification Section.

1.05 APPLICABLE CODES AND REQUIREMENTS

A. Conformance

1. All work, equipment and materials furnished shall conform with the existing rules, requirements and specifications of the following:
 - a. Insurance Rating Organization having jurisdiction
 - b. The serving electrical utility company
 - c. The currently adopted edition of the National Electrical Code (NEC)
 - d. The National Electric Manufacturers Association (NEMA)
 - e. The Institute of Electrical and Electronic Engineers (IEEE)
 - f. The Insulated Cable Engineers Association (ICEA)
 - g. The American Society of Testing Materials (ASTM)
 - h. The American National Standards Institute (ANSI)
 - i. The requirements of the Occupational Safety Hazards Act (OSHA)
 - j. The National Electrical Contractors Association (NECA) Standard of Installation
 - k. National Fire Protection Association (NFPA)
 - l. International Electrical Testing Association (NETA)

- m. All other applicable Federal, State and local laws and/or ordinances.
- 2. All material and equipment shall bear the inspection labels of Underwriters Laboratories, Inc., if the material and equipment is of the class inspected by said laboratories.

B. Nonconformance

- 1. Any paragraph of requirements in these Specifications, or Drawings, deviating from the rules, requirements and Specifications of the above organizations shall be invalid and their (the above organizations) requirements shall hold precedent thereto. The Contractor shall be held responsible for adherence to all rules, requirements and specifications as set forth above. Any additional work or material necessary for adherence will not be allowed as an extra, but shall be included in the Bid. Ignorance of any rule, requirement, or Specification shall not be allowed as an excuse for nonconformity. Acceptance by the Engineer does not relieve the Contractor from the expense involved for the correction of any errors which may exist in the drawings submitted or in the satisfactory operation of any equipment.

C. Certification

- 1. Upon completion of the work, the Contractor shall obtain certificate(s) of inspection and approval from the National Board of Fire Underwriters or similar inspection organization having jurisdiction and shall deliver same to the Engineer and the Owner.

1.06 PERMITS AND INSPECTIONS

- A. The Contractor shall reference the General Conditions and Section entitled "Summary of Work."

1.07 TEMPORARY LIGHTING AND POWER

- A. The Contractor shall reference the General Conditions and Section entitled "Temporary Utilities."

1.08 TESTS

- A. Upon completion of the installation, the Contractor shall perform tests for operation, load (Phase) balance, overloads, and short circuits. Tests shall be made with and to the satisfaction of the Owner and Engineer.
- B. The Contractor shall perform all field tests and shall provide all labor, equipment, and incidentals required for testing and shall pay for electric power required for the tests. All defective material and workmanship disclosed shall be corrected by the Contractor at no cost to the Owner. The Contractor shall show by demonstration in service that all circuits and devices are in good operating condition. Test shall be such that each item of control equipment will function not less than five (5) times.
- C. Refer to each individual specification section for detailed test requirements.

- D. The Contractor shall complete the installation and field testing of the electrical installation at least two (2) weeks prior to the start-up and testing of all other equipment. During the period between the completion of electrical installation and the start-up and testing of all other equipment, the Contractor shall make all components of the Work available as it is completed for their use in performing Preliminary and Final Field Tests.
- E. Before each test commences, the Contractor shall submit a detailed test procedure, and also provide test engineer resume, manpower and scheduling information for the approval by the Engineer. In addition, the Contractor shall furnish detailed test procedures for any of his equipment required as part of the field tests of other systems.

1.09 INFRARED INSPECTION

- A. Just prior to the final acceptance of a piece of equipment, the Contractor shall perform an infrared inspection to locate and correct all heating problems associated with electrical equipment terminations. The infrared inspection shall be performed by a third party, independent testing agency, not the Electrical Contractor.
- B. The infrared inspection shall apply to all new equipment and existing equipment that is in any way modified under this Contract. All heating problems detected with new equipment furnished and installed under the Scope of this Contract shall be corrected by the Contractor. All problems detected with portions of existing equipment modified under this Contract shall also be corrected by the Contractor.
- C. Any issues detected with portions of existing equipment that were not modified under this Contract are not the responsibility of the Contractor. Despite the Contractor not being held responsible for these problems, the Contractor shall report them to the Owner and Engineer immediately for resolution.
- D. The infrared inspection report shall include both digital and IR pictures positioned side by side. Both the digital and IR pictures shall be clear and high quality. Fuzzy, grainy, or poorly illuminated pictures are not acceptable. The IR picture shall be provided with a temperature scale beside it, and an indication of the hot spot temperature in each picture. Reports shall be furnished in a 3-ring binder, with all pages printed in full color, with equipment assemblies separated by tabs.

1.10 PROTECTIVE DEVICE SETTING AND TESTING

- A. The Contractor shall provide the services of a field services organization to adjust, set, calibrate and test all protective devices in the electrical system. The organization shall be a subsidiary of or have a franchise service agreement with the electrical equipment manufacturer. The qualifications of the organization and resumes of the technicians as well as all data forms to be used for the field testing shall be submitted.
- B. All protective devices in the electrical equipment shall be set, adjusted, calibrated and tested in accordance with the manufacturers' recommendations, the coordination study, and best industry practice.

- C. Proper operation of all equipment associated with the device under test and its compartment shall be verified, as well as complete resistance, continuity and polarity tests of power, protective and metering circuits. Any minor adjustments, repairs and/or lubrication necessary to achieve proper operation shall be considered part of this Contract.
- D. All solid state trip devices shall be checked and tested for setting and operation using manufacturers recommended test devices and procedures.
- E. Circuit breakers and/or contactors associated with the above devices shall be tested for trip and close functions with their protective device.
- F. When completed, the Contractor shall provide a comprehensive report for all equipment tested indicating condition, readings, faults and/or deficiencies in same. Inoperative or defective equipment shall be brought immediately to the attention of the Engineer.
- G. Prior to placing any equipment in service, correct operation of all protective devices associated with this equipment shall be demonstrated by field testing under simulated load conditions.

1.11 POWER SYSTEM STUDIES

- A. The Contractor shall provide short circuit studies, protective device evaluation studies, protective device coordination studies, and arc flash studies performed by a registered professional engineer in accordance with Section entitled "Power System Studies."

1.12 SCHEDULES AND FACILITY OPERATIONS

- A. All testing procedures and schedules must be submitted to the Engineer for review and approval one (1) month prior to any work beginning. When testing has been scheduled, the Engineer must be notified 48 hours prior to any work. In addition, any testing that requires temporary shutdown of facility equipment must be coordinated with the Owner/Engineer so as not to affect proper facility operations.
- B. At the end of the workday, all equipment shall be back in place and ready for immediate use should a facility emergency arise. In addition, should an emergency condition occur during testing, at the request of the Owner, the equipment shall be placed back in service immediately and turned over to Owner personnel.
- C. In the event of accidental shutdown of Owner equipment, the Contractor shall notify Owner personnel immediately to allow for an orderly restart of affected equipment.

1.13 MATERIALS HANDLING

- A. Materials arriving on the job site shall be stored in such a manner as to keep material free of rust and dirt and so as to keep material properly aligned and true to shape. Rusty, dirty, or misaligned material will be rejected. Electrical conduit shall be stored to provide protection from the weather and accidental damage. Rigid non-metallic conduit shall be stored on even supports and in locations not subject to direct sun rays or excessive heat. Cables shall be sealed, stored, and handled carefully to avoid damage to the outer covering or insulation and damage from moisture and weather. Adequate protection shall be required at all times

for electrical equipment and accessories until installed and accepted. Materials damaged during shipment, storage, installation, or testing shall be replaced or repaired in a manner meeting with the approval of the Engineer. If space heaters are provided in a piece of electrical equipment, they shall be temporarily connected to a power source during storage. The Contractor shall store equipment and materials in accordance with Section entitled "Materials and Equipment".

1.14 WARRANTIES

- A. Unless otherwise specified in an individual specification section, all equipment and electrical construction materials furnished and installed under Division 16 shall be provided with a warranty in accordance with the requirements of Section entitled "Equipment General Provisions."

1.15 TRAINING

- A. Unless otherwise specified in an individual specification section, all training for equipment furnished and installed under Division 16 shall be provided in accordance with the requirements of Section entitled "Equipment General Provisions."

PART 2 -- PRODUCTS

2.01 PRODUCT REQUIREMENTS

- A. Unless otherwise indicated, the materials to be provided under this Specification shall be the products of manufacturers regularly engaged in the production of all such items and shall be the manufacturer's latest design. The products shall conform to the applicable standards of UL and NEMA, unless specified otherwise. International Electrotechnical Commission (IEC) standards are not recognized. Equipment designed, manufactured, and labeled in compliance with IEC standards is not acceptable.
- B. All items of the same type or ratings shall be identical. This shall be further understood to include products with the accessories indicated.
- C. All equipment and materials shall be new, unless indicated or specified otherwise.
- D. The Contractor shall submit proof if requested by the Engineer that the materials, appliances, equipment, or devices that are provided under this Contract meet the requirements of Underwriters Laboratories, Inc., in regard to fire and casualty hazards. The label of or listing by the Underwriters Laboratories, Inc., will be accepted as conforming to this requirement.

2.02 SUBSTITUTIONS

- A. Unless specifically noted otherwise, any reference in the Specifications or on the Drawings to any article, service, product, material, fixture, or item of equipment by name, make, or catalog number shall be interpreted as establishing the type, function, and standard of quality and shall not be construed as limiting competition. The Contractor, in such cases

may, at his option use any article, device, product, material, fixture, or item of equipment which in the judgment of the Engineer, expressed in writing, is equal to that specified.

2.03 CONCRETE

- A. The Contractor shall furnish all concrete required for the installation of all electrical work, Concrete shall be Class A unless otherwise specified. Concrete and reinforcing steel shall meet the appropriate requirements of Division 3 of the Specifications.
- B. The Contractor shall provide concrete equipment pads for all free-standing electrical apparatus and equipment located on new or existing floors or slabs. The Contractor shall provide all necessary anchor bolts, channel iron sills, and other materials as required. The exact location and dimensions shall be coordinated for each piece of equipment well in advance of the scheduled placing of these pads. Equipment pads shall be 4 inches high unless otherwise indicated on the Drawings and shall conform to standard detail for equipment pads shown on the Contract Drawings. Equipment pads shall not have more than 3" excess concrete beyond the edges of the equipment.
- C. The Contractor shall provide concrete foundations for all free-standing electrical apparatus and equipment located outdoors or where floors or slabs do not exist and/or are not or provided by others under this Contract. The Contractor shall provide all necessary anchor bolts, channel iron sills, and other materials as required. The location and dimensions shall be coordinated for each piece of equipment well in advance of the scheduled placing of the foundations. Equipment foundations shall be constructed as detailed on the Drawings or if not detailed on the Drawings shall be 6 inches thick minimum reinforced with #4 bars at 12-inch centers each way placed mid-depth. Concrete shall extend 6 inches minimum beyond the extreme of the equipment base and be placed on a compacted stone bed (#57 stone or ABC) 6 inches thick minimum.

PART 3 -- EXECUTION

3.01 CUTTING AND PATCHING

- A. Coordination:
 - 1. The Work shall be coordinated between all trades to avoid delays and unnecessary cutting, channeling and drilling. Sleeves shall be placed in concrete for passage of conduit wherever possible.
- B. Damage
 - 1. The Contractor shall perform all chasing, channeling, drilling and patching necessary to the proper execution of his Contract. Any damage to the building, structure, or any equipment shall be repaired by qualified mechanics of the trades involved at the Contractor's expense. If, in the Engineer's judgment, the repair of damaged equipment would not be satisfactory, then the Contractor shall replace damaged equipment at his own expense.
- C. Existing Equipment

1. Provide a suitable cover or plug for openings created in existing equipment as the result of work under this Contract. For example, provide round plugs in equipment enclosures where the removal of a conduit creates a hole and the enclosure. Covers and plugs shall maintain the NEMA rating of the equipment enclosure. Covers and plugs shall be watertight when installed in equipment located outdoors.

3.02 EXCAVATION AND BACKFILLING

- A. The Contractor shall perform all excavation and backfill required for the installation of all electrical work. All excavation and backfilling shall be in complete accordance with the applicable requirements of Division 2.

3.03 CORROSION PROTECTION

- A. Wherever dissimilar metals, except conduit and conduit fittings, come into contact, the Contractor shall isolate these metals as required with neoprene washers, nine (9) mil polyethylene tape, or gaskets.

- END OF SECTION -

SECTION 16055 - POWER SYSTEM STUDIES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall provide Short Circuit Studies, Equipment Evaluation Studies, Protective Device Coordination Studies, Load Flow Analyses, and Arc Flash Hazard Studies performed by a professional electrical engineer currently registered in the State of Florida.
- B. The scope of work for these studies shall include all electrical equipment at the facility, although all electrical equipment may not be shown on the Contract Drawings for this particular project.
- C. Prior to receiving final approval of the shop drawings for the distribution equipment and pump control panel proposed under this Contract, and/or prior to release of that equipment for manufacture, the Preliminary Study Report, as specified herein, shall be submitted and approved. Contractor shall expedite the completion of the Preliminary Study Report so that final approval of proposed equipment is not delayed.

1.02 REFERENCE CODES AND STANDARDS

- A. Institute of Electrical and Electronic Engineers (IEEE):
 - 1. Standard 141, Recommended Practice for Electrical Power Distribution for Industrial Plants
 - 2. Standard 241, Recommended Practice for Electrical Power Systems in Commercial Buildings
 - 3. Standard 242, Recommended Practice for Protection and Coordination of Industrial and Commercial Systems
 - 4. Standard 399, Recommended Practice for Industrial and Commercial Power System Analysis
 - 5. Standard 519-1992, Recommended Practices and Requirements for Harmonic Control in Electric Power Systems
 - 6. Standard 1584-2002/2004a, IEEE Guide for Performing Arc-Flash Hazard Calculations
- B. American National Standards Institute (ANSI):
 - 1. Standard C37.90, IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus
 - 2. Standard C37.91, Guide for Protective Relay Applications to Power Transformers

3. Standard C37.95, Guide for Protective Relaying of Utility-Consumer Interconnections.
4. Standard C37.96, Guide for AC Motor Protection
5. Standard C57.12.59, Guide Dry-Type Transformer Through-Fault Current Duration
6. Standard C.57.13, Standard Requirements for Instrumentation Transformers
7. Standard C57.109, Guide for Liquid-Immersed Transformer Through Fault-Current Duration

C. National Electrical Code (NEC)

D. National Fire Protection Agency (NFPA):

1. NFPA 70E, Standard for Electrical Safety in the Workplace (2015 edition)

1.03 SUBMITTALS

- A. The Contractor shall submit for review and approval, one (1) paper copy of the Preliminary Power System Studies Report, one (1) paper copy of the Pre-final Power System Studies Report, and one (1) paper copy of the Final Power System Studies Report. One (1) electronic copy of each report shall be also submitted. The electronic version of each report shall be in the PDF file format. Each section of the report shall be placed in a separate PDF file to allow fast and easy navigation between sections. Additional details regarding the report requirements are specified elsewhere herein.
- B. All Reports shall bear the signature and seal of the professional electrical engineer that performed the study.
- C. The Contractor shall also submit one (1) electronic copy of the system model and all required database files generated by the software analysis package used. Files shall be placed on a CD and submitted with the Preliminary, Pre-final, and Final Power System Studies Reports.

1.04 QUALIFICATIONS

- A. The Power System Studies shall be performed by a professional electrical engineer registered in the State of Florida. The registered professional electrical engineer shall have a minimum of five (5) years of experience in performing power systems studies.
- B. The resume of the registered professional electrical engineer shall be submitted for approval prior to the start of work. An experience table shall also be provided detailing the power systems studies of similar scope to this Contract that have been performed by the proposed engineer over the last two (2) years. The table shall, at a minimum, list the facility owner's name, facility contact person with phone number and email address, and overall scope of work that was provided.

PART 2 -- PRODUCTS

2.01 POWER SYSTEM STUDIES

A. General

1. The Contractor shall provide Short Circuit Studies, Equipment Evaluation Studies, Protective Device Coordination Studies, Load Flow Analyses, and Arc Flash Hazard Studies for the entire electrical system. The studies shall be performed in accordance with IEEE 399, Recommended Practice for Industrial and Commercial System Power Analysis (IEEE Brown Book).
2. The studies shall include all portions of the electrical distribution system from the serving electric utility company protective devices, the normal and standby power sources down to and including the 208 volt equipment. The studies shall include, but not necessarily be limited to, the transfer switch, control panel, and pump power terminal junction box. System connections and those which result in maximum fault conditions shall be adequately covered in the study.
3. The studies shall be performed with the aid of SKM Systems Analysis Power Tools for Windows (PTW) software, Version 7.0 or newer. No other software analysis packages are acceptable.

B. Data Collection for the Studies

1. The Contractor shall collect all required utility transformer and service information for use in these studies. The serving electric utility representative contact information can be found in Section 16000, Basic Electrical Requirements.

C. Short Circuit Studies

1. The short circuit study shall be performed in accordance with the latest editions of IEEE Std. 399 and IEEE Std. 141.
2. The study input data shall include the serving electric utility company's short circuit contribution, resistance and reactance components of the branch impedances, the X/R ratios, base quantities selected, and other source impedances.
3. Short circuit close and latch duty values and interrupting duty values shall be calculated on the basis of assumed three-phase bolted short circuits at each bus, pertinent branch circuit panel and other significant locations through the system. The short circuit tabulations shall include symmetrical fault currents, and X/R ratios. For each fault location, the total duty on the bus, as well as the individual contribution from each connected branch, shall be listed with its respective X/R ratio.
4. The short circuit study report shall include recommendations for equipment selection based on calculated short circuit values and all input and output data from the software model.

D. Equipment Evaluation Studies

1. An equipment evaluation study shall be performed to determine the adequacy of proposed pump control panel, circuit breakers, transfer switches, etc. located at the pump station by tabulating and comparing the short circuit ratings of these devices with the calculated fault currents. Appropriate multiplying factors based on system X/R ratios and protective device rating standards shall be applied. A table shall be provided in the report showing the calculated fault currents and the corresponding short circuit ratings of the existing equipment.

E. Protective Device Coordination Studies

1. A protective device coordination study shall be performed to provide the necessary calculations and logic decisions required to select or to check the selection of power fuse ratings, protective relay characteristics and settings, ratios and characteristics of associated current transformers, and low voltage circuit breaker trip characteristics and settings.
2. The coordination study shall include all low voltage classes of equipment from the serving electric utility company service protective devices down to and including all adjustable circuit protective devices. The phase and ground overcurrent protection shall be included as well as settings of all other adjustable protective devices.
3. The time-current characteristics of the proposed protective devices shall be printed on a log-log scale. The plots shall include complete titles, representative one-line diagram and legends, significant motor starting characteristics, complete parameters of transformers, complete operating bands of low voltage circuit breaker trip curves and fuses. The coordination plots shall indicate the types of protective devices selected, proposed relay taps, time dial and instantaneous trip settings, transformer magnetizing inrush and ANSI transformer withstand parameters, cable thermal overcurrent withstand limits and significant symmetrical and asymmetrical fault currents. All restrictions of the National Electrical Code shall be adhered to and proper coordination intervals and separation of characteristic curves shall be maintained. The coordination plots for phase and ground protective devices shall be provided on a system basis. A sufficient number of separate curves shall be used to clearly indicate the coordination achieved.
4. The selection and settings of the protective devices shall be provided separately in a tabulated form listing circuit identification, IEEE device number, current transformer ratios and connections, manufacturer and type, range of adjustment and recommended settings.

F. Load Flow Analyses

1. A load-flow analysis shall be performed to determine the steady-state loading profile of the plant. The analysis shall be based on both the serving electric utility as a source and the standby generator as a source. From the results of the load flow analysis, the report shall indicate areas of overloaded conductors or equipment in the power distribution system design.
2. The report shall also include a total source load summary table, as well as single line diagrams showing only the load flow data.

3. Load flow analysis results shall also be presented in a tabular format in the report.

G. Arc Flash Hazard Studies

1. An Arc Flash Hazard Study shall be performed in accordance with IEEE Std. 1584, NFPA 70E, and OSHA 29-CFR, Part 1910 Subpart S.
2. The Arc Flash Hazard Study Report shall include but not be limited to the following:
 - a. An executive summary outlining the electrical distribution system
 - b. A brief overview of what arc flash hazards are and how to avoid them.
 - c. Serving electric utility information received. Copies of the information received shall be included in an appendix.
 - d. All assumptions made to complete the report
 - e. Definitions of key terms used in the report
 - f. Any recommendations to reduce the arc flash incident energies where they are found to exceed a hazard risk category of 2.
 - g. A PPE table that defines the Personnel Protective Equipment (PPE) classes and clothing descriptions identified in the report and labels.
 - h. Arc flash hazard warning labels as specified herein.
 - i. An NFPA 70E energized work permit for each location where a warning label is provided.
 - j. Arc flash evaluation summary sheets as specified herein
 - k. Separate set of single line diagrams that show incident energies, hazard risk categories, and protective device settings. Only pertinent arc flash hazard data shall be displayed on these single line diagrams. Data from all other study calculations shall not be shown.
3. The following parameters shall be used in the Arc Flash Hazard Study:
 - a. Working distance for all equipment: 18"
 - b. Maximum arc duration for all equipment: 2 seconds
 - c. Incident energies, arc flash hazard boundaries, and hazard risk categories shall be calculated over a +/- 15% of calculated arcing fault current. The worst case incident energies that result shall be used in the study report.
 - d. The equipment that connects to both the electric utility service and the standby power is in an open-transition configuration. The power sources are incapable of paralleling with each other.

- e. The arc flash analysis shall be performed as if the facility is being supplied by the electric utility **and** as if the facility is being supplied by the standby generator. The worst case values from each calculation shall be used in the study report.
4. Arc Flash Warning Labels shall be produced for each location that allows access to energized parts. Labels shall be printed in color on adhesive backed labels. Labels shall be an ANSI Z535.4 compliant (minimum size 4 in. x 6 in.) thermal transfer type label. For incident energy values of less than 40 cal/cm², the labels shall have an orange colored header with the word "WARNING". For incident energy values equal to and above 40 cal/cm², the labels shall have a red colored header with the word "DANGER". Each label shall include the following information:
- a. Bus name
 - b. System operating voltage
 - c. Date of issue
 - d. Flash hazard protection boundary
 - e. Limited approach boundary
 - f. Restricted boundary
 - g. Prohibited boundary
 - h. Incident energy level
 - i. Required personal protective equipment class (Hazard risk category)
5. Arc Flash Evaluation Summary Sheets shall be produced. All values shown on the Summary Sheets shall be commensurate with the values shown on the single line diagrams. Summary sheets shall list the following:
- a. Bus name
 - b. Upstream protective device name and protective device settings
 - c. Bus line-to-line voltage
 - d. Bus bolted fault
 - e. Protective device bolted fault current
 - f. Arcing fault current
 - g. Protective device trip / delay time
 - h. Breaker opening time
 - i. Solidly grounded column

- j. Equipment type
- k. Gap
- l. Arc flash boundary
- m. Working distance
- n. Incident energy
- o. Required personal protective equipment class (hazard risk category)

2.02 Study Reports

- A. The results of the Power Systems Studies shall be summarized in a series of reports. A total of three (3) separate reports shall be provided as follows:
 - 1. Preliminary Report – The Preliminary Report shall consist of all power systems studies as specified herein, with the following exceptions:
 - a. NFPA 70E energized work permits shall not be included
 - b. Arc flash hazard warning labels shall be printed on plain paper for format review purposes only. Actual labels with calculated values shall not be included.
 - 2. Pre-final Report – The Pre-final Report shall incorporate all comments received from the previous report review and shall include specific equipment data from the approved shop drawings of the proposed electrical equipment. The Pre-final Report shall consist of all power systems studies as specified herein, with the following exceptions:
 - a. NFPA 70E energized work permits shall not be included
 - b. Sample arc flash hazard warning labels shall be printed on plain paper for calculated value review purposes. Actual adhesive labels shall not be included.
 - 3. Final Report – The Final Report shall consist of all power systems studies as specified herein, including final adhesive arc flash hazard warning labels. Final report shall incorporate all installed electrical equipment, including any field changes made during construction, and all comments received from the previous report review. All 'as-left' protective device settings shall be included in the report.
- B. Reports shall be furnished in the quantities specified herein, neatly organized into properly identified 1.5" (minimum) 3-ring binders. Tabs shall clearly separate each section of the report. Each report shall begin with a table of contents. The following sections shall be included in the report as a minimum:
 - 1. Executive Summary
 - 2. Short Circuit Study

3. Equipment Evaluations
 4. Protective Device Coordination Study
 - 5 Load Flow Analysis
 6. Arc Flash Study
- C. All data used in the reports such as conductor sizes and lengths, motor sizes, utility contribution information, and the like shall be included in the appendices of the report.
- D. All single line diagrams and time current curves shall be provided in the reports on 11x17 paper, properly folded to fit into the report binder. Use of standard 8.5x11 paper for these purposes is not permitted. Single line diagrams shall be appropriately split up between several sheets (if required) to allow the drawing scale to be adjusted in order to make text and symbols legible.

PART 3 – EXECUTION

3.01 FIELD ADJUSTMENT

- A. Contractor shall adjust all relay and protective device settings according to the recommended settings table provided in the approved Pre-Final Report.
- B. Contractor shall make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.

3.02 ARC FLASH LABELS

- A Contractor shall place approved adhesive arc flash labels on equipment after the Final Report is reviewed and approved.

3.03 TRAINING

- A. The Contractor shall train the Owner's qualified electrical personnel of the potential arc flash hazards associated with working on energized equipment (minimum of 4 hours). The training shall be certified for continuing education units (CEUs) by the International Association for Continuing Education Training (IACET) or equivalent.

- END OF SECTION -

SECTION 16111 - CONDUIT

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Under this Section, the Contractor shall furnish and install all conduits and conduit fittings to complete the installation of all electrically operated equipment as specified herein and as required.
- B. The Drawings indicate the general location of conduits both exposed and concealed; however, the Contractor shall install these conduits in such a manner to avoid all interferences.
- C. Reference Sections entitled "Basic Electrical Requirements" and "Electrical Identification."
- D. All Contractor personnel installing PVC coated rigid conduit shall be trained as specified herein.

1.02 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section entitled "Submittals," the Contractor shall obtain from the equipment manufacturer and submit shop drawings. Each submittal shall be identified by the applicable Specification section.

1.03 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
 - 1. Product data sheets.
 - 2. Conduit identification methods and materials.
 - 3. Evidence of training (e.g. Certificates of Completion) for all Contractor personnel that will install PVC coated rigid conduit. Training shall be as specified herein.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

- A. The material covered by this Specification is intended to be standard material of proven performance as manufactured by reputable concerns. Material shall be fabricated, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as specified herein and shown on the Drawings.

2.02 CONDUITS

- A. All components (fittings, couplers, connectors, etc.) of the conduit system shall be of the same or compatible material of construction. Coated conduit systems shall include factory coated fittings couplings, connectors, and other components compatible with and approved for coated conduit systems.

Reference the "Conduit Uses" portion of this specification for additional information regarding conduit.

B. Liquid-Tight Flexible Metal Conduit

- 1. Liquid-tight flexible conduit (LFMC) shall be galvanized steel, single strip, with a copper strip interwoven and suitable as a grounding means. LFMC shall be UL listed. LFMC shall have an extruded moisture and oil-proof PVC jacket. LFMC shall be Titan Type UL as manufactured by Southwire, Liqueflex Type "LA" as manufactured by Electri-Flex, Anaconda Type UA as manufactured by Anamet Electrical, Inc., or equal.
- 2. PVC coated or stainless-steel watertight connectors shall be used with liquid-tight flexible metal conduit on both ends. LFMC shall be used to connect all vibrating equipment installed outdoors, in wet or damp areas, and other applications as directed by the Engineer.

C. Rigid Nonmetallic Conduit

- 1. Rigid nonmetallic conduit shall be Schedule 40 polyvinyl chloride (PVC), 90°C, UL rated and shall conform to NEMA TC-2. Fittings and conduit bodies shall conform to NEMA TC3.
- 2. Rigid non-metallic conduit shall be as manufactured by Carlon, Triangle Conduit and Cable, Cantex, Inc., or equal.

D. PVC Coated Metallic Conduit

- 1. PVC coated rigid steel conduit shall be furnished and installed as specified herein and indicated on the Drawings. The product shall be rigid galvanized steel conduit covered with a bonded 40 mil (minimum) thickness PVC jacket and coated inside with urethane. The conduit shall comply with NEMA RN-1 and shall be "Plasti-Bond Red" as manufactured by Robroy Industries, "OCAL-Blue" as manufactured by

Thomas & Betts, Perma-Cote Supreme by Perma-Cote Industries, Kor Kap equivalent, or equal.

E. Conduit Fittings

1. Fittings for all conduit types shall conform to UL 467 and UL 514 as applicable.
2. Fittings for electrical metallic tubing shall be rain-tight and concrete-tight, and shall be plated steel hexagonal threaded compression type.
3. Set screw or indentor type connectors shall not be used. Fittings for conduit installed in wet locations and underground shall provide a watertight joint. Fittings for rigid conduit shall be threaded.
4. Fittings or bushings shall be installed in easily accessible locations.
5. Where exposed conduits pass across structural expansion joints, approved weatherproof telescopic type expansion fittings shall be used. Fittings shall be OZ/GEDNEY Type AX, Crouse-Hinds Type XJG, or equal, watertight, and permit movement up to 4 inches. Each fitting shall be equipped with approved bonding jumpers around or through each fitting.

Where embedded conduits pass through expansion joints, approved watertight, concrete-tight deflection/expansion fittings shall be used. Fittings shall compensate for movement of $\frac{3}{4}$ -inch from the normal in all directions. Fittings shall be OZ/GEDNEY Type DX, Crouse-Hinds Type XD, or equal.

6. Conduit fittings ("condulets") shall be used on exposed conduit work for changes in direction of conduit runs and breaking around beams. "Condulets" shall be cast ferrous alloy, galvanized or cadmium plated, as manufactured by Crouse-Hinds, OZ/Gedney, Appleton Company, or equal. Coated fittings and boxes shall be used with coated conduit in all chemically aggressive areas or where called for on the Drawings. Covers shall be of a design suitable for the purpose intended. In damp areas, the outside condulets shall be made watertight. Install all condulets with the covers accessible. Use proper tools to assemble conduit system to prevent injury to the plastic covering. No damage to the covering shall be permitted.
7. Conduit fittings shall be cast type of non-ferrous metal or malleable iron thoroughly coated inside and outside with metallic zinc or cadmium after all machining has been completed. Cast fittings shall be provided with heavy threaded hubs to fit the conduit required. Covers shall be of the same material as the fittings to which they are attached and shall be screwed on with rubber or neoprene gaskets between the covers and fittings. Cast fittings 1-1/2 inches and above shall be of the "mogul" type.
8. PVC coated fittings shall be used with PVC coated conduit. All conduit nipples, elbows, couplings, boxes, fittings, unions, expansion joints, connectors, bushing, and other components of the raceway system shall be factory coated to maintain the corrosion-resistant integrity of the conduit system. The coated conduit and its respective components shall all be provided by the same manufacturer. Coated conduit shall be used in all areas specified herein or indicated on the Drawings.

PART 3 -- EXECUTION

3.01 CONDUIT AND FITTINGS

- A. Unless otherwise specified herein or indicated on the Drawings, the minimum size conduit shall be 3/4 inch for exposed work and 1 inch for conduit encased in concrete or mortar. The Contractor, at his option, for ease of installation to accommodate saddle size, may increase the size of encased conduits to 2-inch. However, no combining of circuits/conductors will be permitted in these larger conduits.
- B. Conduit shall be installed concealed unless otherwise indicated or specified. Conduit may be run exposed on walls only where concealing is not practical, or at the direction of the Engineer.
- C. Where exposed, maintain a minimum distance of 6 inches from parallel runs of flues or water pipes. Conduit runs shall be installed in such locations as to avoid steam or hot water pipes. A minimum separation of 12 inches shall be maintained where conduit crosses or parallels hot water or steam pipes.
- D. A non-metallic raceway containing instrumentation cable (if specifically allowed herein) where installed exposed shall be installed to provide the following clearances:
 - 1. Raceway installed parallel to raceway conductors energized at 480 through 208 volts shall be 18 inches and 208/120 volts shall be 12 inches.
 - 2. Raceway installed at right angles to conductors energized at 480 volts or 120/208 volts shall be 6 inches.
- E. Where practical, exposed raceways containing instrumentation cable shall cross raceway containing conductors of other systems at right angles.
- F. For floor mounted equipment, conduit may be installed overhead and dropped down, where underfloor installation is not practical. Groups of conduits shall be uniformly spaced, where straight and at turns. Conduit shall be cut with a hacksaw or an approved conduit-cutting machine and reamed after threading to remove all burrs. Securely fasten conduit to outlets, junction and pull boxes to effect firm electrical contact. Join conduit with approved couplings. Conduits shall be freed from all obstructions.
- G. Empty conduit systems shall be furnished and installed as indicated on the Drawings and shall have pull ropes installed. The polyethylene pull ropes shall be 1/4" diameter, minimum. Not less than 12 inches of slack shall be left at each end of the pull rope.
- H. Each piece of conduit installed shall be free from blisters or other defects. Each piece installed shall be cut square, taper reamed, and a coat of galvanizing and conducting compound shall be applied to the threads. Galvanizing compound shall be CRC Zinc-It or equal. Threads on conduits shall be painted with a conducting compound prior to making up in a fitting. Conduit connections shall be made with standard coupling and the ends of the conduit shall butt tightly into the couplings. Where standard coupling cannot be used, Erickson three-piece couplings shall be used. Where conduits are installed in concrete, concrete-tight three-piece couplings shall be used.

- I. Conduit threaded in the field shall be of standard sizes and lengths.
- J. All bends shall be made with standard factory conduit elbows or field bent elbows. Field bending of conduit shall be done using tools approved for the purpose. Heating of conduit to facilitate bending is prohibited. Field bends shall be not less than the same radius than a standard factory conduit elbow. Bends with kinks shall not be acceptable.

The equivalent number of 90° bends in a single conduit run are limited to the following:

- | | | |
|----|-------------------------------|---|
| 1. | Runs in excess of 300 feet: | 0 |
| 2. | Runs of 300 feet to 201 feet: | 1 |
| 3. | Runs of 200 feet to 101 feet: | 2 |
| 4. | Runs of 100 feet and less: | 3 |

- K. Unless otherwise specified herein, indicated on the Drawings, or required by the NEC, conduit shall be supported every 8 feet (minimum) and shall be installed parallel with or perpendicular to walls, structural members, or intersections of vertical planes and ceilings with right angle turns consisting of fittings or symmetrical bends. Conduits shall be supported within 1 foot of all changes in direction. Supports shall be approved pipe straps, wall brackets, hangers or ceiling trapeze. Supports shall be in accordance with Section entitled "Supporting Devices."
- L. In no case shall conduit be supported or fastened to another pipe or installed to prevent the removal of other pipe for repairs. Fastenings shall be by expansion bolts on concrete; by machine screws, welded threaded studs, or spring-tension clamps on steel work. Powder actuated fasteners may only be used to make connections where the use of this equipment complies with safety regulations and for structures in Seismic Design Categories A or B, unless the fasteners are approved for seismic use. Wooden plugs inserted in masonry and the use of nails as fastening media are prohibited. Threaded C-clamps may be used on rigid steel conduit only. Conduits or pipe straps shall not be welded to steel.
- M. The load applied to fasteners shall not exceed 1/4 of the proof test load. Fasteners attached to concrete ceilings shall be vibration and shock resistant. Holes cut to a depth of more than 1-1/2 inches in reinforced concrete beams or to a depth of more than 3/4 inch in concrete joints shall not cut the main reinforcing bars. Holes not used shall be filled. Conduits shall be fastened to all sheet metal boxes and cabinets with two (2) locknuts where required by the National Electrical Code to ensure adequate bonding for grounding. Where insulated bushings are used, or where bushings cannot be secured firmly to the box or enclosure, a bonding jumper shall be installed to maintain suitable grounding continuity. Locknuts shall be the type with sharp edges for digging into the wall of metal enclosures. Bushings shall be installed on the ends of all conduits and shall be of the insulating type where required by the National Electrical Code.
- N. Conduit installed in concrete floor slabs or walls shall be located so as not to affect the designed structural strength of the slabs. Conduit shall be installed within the middle one-third of the concrete slab except where necessary to not disturb the reinforcement. The outside diameter of conduit shall not exceed one-third of the slab thickness, and conduits shall be spaced no closer than three (3) diameters except at cabinet locations. Curved

portions of bends shall not be visible above the finish slab. Where embedded conduits cross expansion joints, suitable expansion/deflection fittings and bonding jumpers shall be provided. Conduit larger than 1-inch trade size shall be parallel with or at right angles to the main reinforcement. When at right angles to the reinforcement, the conduit shall be close to one of the supports of the slab. Conduits shall not be stacked more than two (2) diameters high in floor slabs. Embedded conduits shall be placed in accordance with the latest edition of ACI-318.

- O. Install polyvinyl chloride (PVC) coated steel conduits when entering or exiting concrete except under electrical equipment where the conduit is not subject to physical abuse. Also install PVC coated steel conduit when transitioning between grade and a structure or an equipment stand. Extend stub-ups at least 12 inches above and below grade or finish floor. Conduits extending through the concrete floor shall be installed using straight runs (for vertical penetrations) or factory elbows (for conduits installed within the slab) of PVC coated rigid steel conduit.
- P. All conduit extending through the floor behind panels or into control centers or similar equipment may be PVC Schedule 40 and shall extend a minimum of 6 inches above the floor elevations, where practicable, with no couplings at floor elevations.
- Q. Unless specifically identified on the Drawings as "Direct Buried," all conduits in the earth, except conduits below slabs-on-grade, shall be concrete encased. Joints in conduit shall be staggered so as not to occur side by side. Rigid non-metallic (PVC) conduit shall be connected to PVC coated rigid steel conduit at the point where it leaves the ground, with the transition to PVC coated conduit occurring inside the concrete encasement.
- R. No more than three (3) 90-degree bends will be allowed in any one conduit run. Where more bends are necessary, a conduit bender, and all larger sizes shall have machine bends. Joints in threaded conduit shall be made up watertight with the appropriate pipe thread sealant or compound applied to male threads only; and, all field joints shall be cut square, reamed smooth, and properly threaded to receive couplings. No running threads are permitted. All conduit ends at switch and outlet boxes shall be fitted with an approved locknut and bushing forming an approved tight bond with box when screwed up tightly in place.
- S. Conduits stubbed up through concrete floors for connections to freestanding equipment and for future equipment shall be provided with an adjustable top or coupling threaded inside for plugs, set flush with the finished floor. Screwdriver operated threaded flush plugs shall be installed in conduits from which no equipment connections are made.
- T. Where outlets are shown near identified equipment furnished by this or other Contractors, it is the intent of the Specifications and Drawings that the outlet be located at the equipment to be served. The Contractor shall coordinate the location of these outlets to be near the final location of the equipment served whether placed correctly or incorrectly on the Drawings. Changes in outlet locations required to serve the equipment furnished by other Contractors on the Project shall be brought to the attention of the Engineer.
- U. Conduit shall be protected immediately after installation by installing flat non-corrosive metallic discs and steel bushings, designed for this purpose, at each end. Discs shall not be

removed until it is necessary to clean the conduit and install the conductors. Before the conductors are installed, insulated bushings shall be installed at each end of the conduit.

- V. Where "all-thread" nipples are used between fittings and electrical equipment, they shall be so installed that no threads are exposed.
- W. Connections from rigid conduit to motors and other vibrating equipment, limit switches, solenoid valves, level controls, and similar equipment, shall be made with short lengths of liquid-tight flexible metal conduit. These conduits shall be installed in accordance with the NEC and shall be furnished and installed with appropriate connectors with devices which will provide an excellent electrical connection between the equipment and the rigid conduit for the flow of ground current. Liquid-tight flexible metal conduit length shall be three (3) feet, maximum.
- X. Liquid-tight flexible metal conduit installed between rigid metal conduit and motor terminal box and/or any other apparatus shall have a green insulated grounding conductor running through the flexible conduit. This conductor shall be terminated to the nearest pull box, motor terminal box, or any other apparatus ground terminal. Liquid-tight flexible metal conduit shall be grounded and bonded per NEC Articles 348 and 350, respectively.
- Y. Conduits installed within or underneath floor slabs, underground direct-buried or concrete encased conduits, and all conduits installed in areas subject to liquid inadvertently entering the conduit system shall be sealed or plugged at both ends in accordance with NEC Article 300-5(g). This requirement applies to both conduits containing conductors and "spare" conduits. Where practicable, the interior of the conduit shall be sealed as well as around the conductors by using conduit sealing bushings: Type CSB as manufactured by O/Z Gedney, or equal. Where the conduit fill does not allow the use of these bushings, the conduits shall be tightly caulked or plugged.

Conduit passing through the walls and floors of buildings below grade shall be installed with appropriate watertight fittings to prevent the entrance of ground water around the periphery of the conduits. For vertical conduit penetrations through openings in concrete floors, the fittings shall be Type FSK Floor Seals as manufactured by OZ/Gedney. For conduit penetrations through openings in concrete walls, the fittings shall be Type WSK Thruwall seals as manufactured by OZ Gedney. Conduits shall be sloped away from the buildings toward splice boxes, handholes and/or manholes to provide drainage away from the building wall.

Conduits passing through sleeves in interior walls and floors shall be tightly caulked.

- Z. Weatherproof, insulated throat "Meyers" hubs shall be used on all conduit entries to boxes and devices without integral hubs in process areas to maintain NEMA 4X integrity. The Contractor shall furnish and install "Meyers" hubs on all conduit entries into non-cast enclosures such as metallic or non-metallic control panels, control component enclosures, wireways, pull boxes, junction boxes, control stations, and similar type equipment when this type of equipment is located in process areas requiring NEMA 4X integrity. This specified requirement for "Meyers" hubs does not apply to any area of the facilities where NEMA 4X integrity is not required.

- AA. The use of two (2) locknuts, one on each side of the enclosure, and a grounding bushing shall be required at all conduit terminations where hub type fittings are not required; such as electrical rooms, control rooms, and office areas.
- AB. Conduit installation shall be arranged to minimize cleaning. No horizontal runs of conduit will be permitted in brick or masonry walls.
- AC. Install non-metallic conduits in accordance with manufacturer's instructions where specified herein or indicated on the Drawings.
- AD. Join non-metallic conduit using cement as recommended by the manufacturer. Clean and wipe non-metallic conduit dry before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for twenty (20) minutes (minimum).
- AE. All PVC coated conduit shall be installed in accordance with manufacturer's instructions. The Contractor shall use tools that are specifically suited for coated conduit systems. The use of pipe wrenches and other such tools on PVC coated RGS conduit is prohibited. The Engineer and Owner reserve the right to reject any installation of coated conduit that does not meet the requirements of the Section or the manufacturer's instructions. The Engineer and Owner also reserve the right to reject any installation that exhibits damage due to the improper use of tools. All rejected installations shall be replaced by the Contractor at no additional cost to the Owner. The use of PVC coated conduit repair compounds to repair damages or improper installation is prohibited.
- AF. All Contractor personnel that install PVC coated RGS conduit shall be trained by the PVC coated RGS conduit manufacturer. Training shall include proper conduit system assembly techniques, use of tools appropriate for coated conduit systems, and field bending/cutting/threading of coated conduit. The Contractor shall furnish evidence of such training as specified herein. Training shall have been completed within the past 24 months prior to the Notice to Proceed on this Contract for all coated conduit installation personnel. Contractor personnel not trained within this timeframe shall not be allowed to install coated conduit, or shall be trained/re-trained as required prior to commencement of conduit installation.
- AG. Conduits shall not penetrate the floors or walls inside liquid containment areas unless specifically accepted by the Engineer.
- AH. All conduits that are buried or encased in concrete that transition from the ground to any stationary structure or equipment shall be equipped with a longitudinal expansion coupling capable of at least four inches of expansion. Conduits with encasement that is rigidly tied to the stationary structure in accordance with the Standard Details shall not be required to have expansion couplings.
- AI. Raceways shall not be installed concealed in water-bearing walls and floors.

3.02 CONDUIT USES AND APPLICATIONS

- A. No PVC conduit shall be installed exposed.
- B. Unless otherwise indicated, all conduit installed in concrete slabs shall be PVC Schedule 40.

- C. All below grade conduit shall be PVC Schedule 40 conduit shall be installed in reinforced concrete encasement, unless otherwise indicated. Conduit shall be "direct buried" only if specifically indicated on the Drawings.
- D. All instrumentation wire and cable for analog signals shall be installed in PVC coated rigid steel conduit. This applies to all conduit installations including exposed, concealed in concrete encasement, and all other applications.
- E. All exposed conduit shall be PVC coated rigid steel conduit.
- F. Other conduit uses not specifically listed above shall be brought to the attention of Engineer for a decision.

3.03 CONDUIT IDENTIFICATION

- A. Exposed conduits shall be identified at the source, load, and all intermediate components of the raceway system. Examples of intermediate components include but are not limited to junction boxes, pull boxes, condulets, and disconnect switches. Identification shall be by means of an adhesive label with the following requirements:
 - 1. Labels shall consist of an orange background with black text. Text for the label shall be developed by the CONTRACTOR. The label shall identify the source and destination of the conduit. The first line of the label shall consist of the word "FROM:", and a suitable description of the source (e.g. FROM: CONTROL PANEL). The second line of the label shall consist of the word "TO:", and a suitable description of the destination (e.g. TO: FIT-101).
 - 3. For conduits ¾" through 1½" in size, the text shall be a minimum 18-point font. For conduits 2" and larger, the text shall be a minimum 24-point font.
 - 4. Label height shall be ¾" minimum, and length shall be as required to fit required text. The label shall be installed such that the text is parallel with the axis of the conduit. The label shall be oriented such that the text can be read without the use of any special tools or removal of equipment.
 - 5. Labels shall be installed after each conduit is installed and, if applicable, after painting. Labels shall be printed in the field via the use of a portable label printing system. Handwritten labels are not acceptable.
 - 6. Labels shall be made of permanent vinyl with adhesive backing as manufactured by Brady, Seton equivalent, Panduit equivalent, or equal. Labels made of any other material are not acceptable.
- B. Conduits that are not exposed but installed beneath free standing equipment enclosures shall be identified by means of a plastic tag with the following requirements:
 - 1. The tag shall be made of white Tyvek material, and have an orange label with black text, as described above.
 - 2. The tag shall be affixed to the conduit by means of a nylon cable tie. The tag shall be of suitable dimensions to achieve a minimum text size of 18 points.

- 3. Tags shall be White Tyvek as manufactured by Brady, Seton equivalent, Panduit equivalent, or equal.
- C. Alternatives to this proposed conduit identification method shall be submitted to the Engineer as part of the shop drawing submittal.
- D. Any problems or conflicts with meeting the requirements above shall immediately be brought to the attention of the Engineer for a decision.

3.04 TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:
 - 1. Field Tests
 - a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 1, and Section entitled "Basic Electrical Requirements."
 - b. All conduit installed below grade or concrete encased shall be tested to ensure continuity and the absence of obstructions by pulling through each conduit a swab followed by a mandrel 85% of the conduit inside diameter. After testing, all conduits shall be capped after installation of a suitable pulling tape.

- END OF SECTION -

SECTION 16118 - UNDERGROUND ELECTRICAL

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install underground duct systems and electric handholes as specified herein and as indicated on the Drawings. The work shall be complete and shall include excavation, concrete construction, backfilling, and all materials, items, and components required for a complete system.
- B. The provisions of this Division are applicable to all underground conduit work. All work shall be coordinated with that of the various utility companies and other Contractors. The Contractor shall adhere to all utility company requirements including the serving electric utility.
- C. Reference Sections entitled "Basic Electrical Requirements"; "Conduit"; "Grounding and Bonding"; the applicable sections of Division 2, Sitework; Sections entitled "Reinforcing Steel"; and "Cast-In-Place Concrete."

1.02 CODES AND STANDARDS

- A. Products specified herein shall be designed, manufactured, and/or listed to the following standards as applicable:
 - 1. AASHTO H20
 - 2. ANSI/SCTE 77-2010 – Specification for Underground Enclosure Integrity

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section entitled "Submittals," the Contractor shall obtain from the equipment manufacturer and submit Shop Drawings. Each submittal shall be identified by the applicable Specification Section.

1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to, the following:
 - 1. Product data sheets.

2. Outline and dimensional drawings including detailed sections of the handholes.

1.04 IDENTIFICATION

- A. Each electric handhole cover shall be lettered with the word "Electric", the handhole identification number (e.g. EHH-1, per schedule), manufacturer's name or trademark, and such other information as the manufacturer may consider necessary, or as specified, for complete identification.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

- A. The material covered by this Specification is intended to be standard material of proven performance as manufactured by reputable concerns. Material shall be fabricated, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as specified herein and indicated on the Drawings.

2.02 DUCT SYSTEM

- A. Underground duct system shall consist of parallel runs of Schedule 40 PVC conduit or PVC coated rigid galvanized steel conduit encased in concrete envelopes, unless otherwise specified herein or indicated on the Drawings.
- B. Nonmetallic conduit joints shall be made with standard Schedule 40 PVC couplings and PVC solvent cement of the same manufacturer as the conduit. All PVC conduit shall be supplied by the same manufacturer. All joints shall be staggered, installed in accordance with the manufacturer's recommendations, and made watertight.
- C. Base and intermediate conduit spacers shall be furnished to provide a minimum of two-inch (2") separation between conduits. Conduit spacers shall be provided in the proper size as required for the conduit that they secure. For example, a 4" conduit spacer shall not be used to secure a 2" conduit. Conduit spacers shall be as manufactured by Carlon Electrical Products Company, Aeroquip Corporation, Underground Devices, Incorporated, or equal.
- D. All 90 degree conduit elbows and/or combinations of adjacent conduit elbows that form a 90 degree bend shall be PVC coated rigid galvanized steel conduit.

2.03 ELECTRIC HANDHOLES

- A. The electric handholes shall be a precast polymer concrete enclosure suitable for use as part of an underground electric raceway system. The enclosure shall meet or exceed the requirements of ANSI/SCTE 77-2010.
- B. The enclosure design and test load rating shall be Tier 15.
- C. The enclosure shall be the straight side design to allow easy adjustment of box to grade. The box shall be stackable for increased depth.

- D. Handhole opening size shall be as required to suit the application, 6" X 8", minimum.
- E. Extra heavy duty covers shall be furnished and installed with Tier 15 enclosures. Covers shall be provided with cover hooks.
- F. The electric handholes shall be Style "PG" or "PC" (as required) Quazite boxes as manufactured by Hubbell, Pencil Plastics equivalent, Highline Products equivalent, or equal.

PART 3 -- EXECUTION

3.01 GENERAL

- A. The underground duct system and handholes shall be installed as specified herein, indicated on the Drawings, and in accordance with manufacturers' instructions.

3.02 DUCT SYSTEM

- A. All underground conduit shall be encased in concrete and shall be reinforced. Encasement and reinforcement shall be as indicated in the standard details. Concrete and reinforcing steel shall be furnished and installed in accordance with Section entitled "Concrete and Grout."
- C. Conduit ductbank elevations at the handholes shall be based on minimum ductbank cover as indicated in the standard details, or deeper to avoid conflicts with other obstacles. Where deviation is necessary to clear unforeseen obstacles, the elevations may be changed after authorization by the Engineer.
- D. Slope all conduits continuously away from structures and buildings with a minimum slope of 3" per 100' unless otherwise indicated on the Drawings.
- E. The minimum clearance from the top of the concrete encasement and finished grade shall be as indicated in the standard details, except where otherwise accepted in writing by the Engineer or shown on the Drawings.
- F. Care shall be exercised during excavation for the duct banks to prevent digging too deep. Backfilling of low spots with earth fill will not be permitted unless thoroughly compacted and acceptable to the Engineer.

- G. If a specific ductbank arrangement is shown on the Drawings, the conduits in that ductbank shall be arranged as shown. Where no specific ductbank arrangement is shown on the Drawings, the Contractor shall arrange conduits within each ductbank based on field conditions. Spare conduits shown going from ductbanks into buildings or structures shall be stubbed up in the location(s) as indicated on the Drawings.
- H. A minimum of one (1) ground rod, furnished in accordance with Section entitled "Grounding and Bonding," shall be driven adjacent to each handhole, or other concrete box. A No. 4/0 AWG bare copper ground cable shall be connected between this rod and the copper ground strap using a silicon bronze connector. All ground rods shall be interconnected by means of the No. 4/0 AWG bare copper ground cable located within each duct bank. The ends of these cables shall also be connected to substation and/or building ground buses where the conduits terminate.
- I. Care shall be exercised and temporary plugs shall be installed during installation to prevent the entrance of concrete, mortar, or other foreign matter into the conduit system. Conduit spacers shall be utilized to support conduit during the pouring of concrete to prevent movement and misalignment of the conduits. Conduit spacers shall be installed in accordance with manufacturer's instructions unless otherwise noted. Horizontal spacing of conduit spacers along ductbank shall be as indicated on the Standard Details.
- J. Large radius elbows shall be used for all 90 degree conduit bends in the duct system. The following shall be the minimum elbow radii:

TRADE SIZE	1"	1 ½"	2"	2 ½"	3"	3 ½"	4"
MIN. RADIUS	12"	24"	24"	24"	36"	36"	48"

- K. Prior to pulling cables, the Contractor shall thoroughly clean the inside of each length of conduit by swabbing.
- L. After all cables have been installed, all spare and/or unused conduit openings shall be sealed or plugged as specified in Section entitled "Conduit." A 250 lb. test pull rope shall be provided in the entire length of all spare and/or unused conduits.
- M. Where connections to existing underground conduits are indicated, excavate to the maximum depth necessary. After addressing the existing conductors, cut the conduits and remove loose concrete from the conduits before installing new concrete encased ducts. Provide a reinforced concrete collar, poured monolithically with the new duct line, to take the shear at the joint of the duct lines.
- N. Six (6) inches above all duct banks, the Contractor shall furnish and install a two (2) inch wide red plastic electrical hazard tape. Tapes shall be metallic detectable type and shall have a continuous message in bold black letters: "ELECTRIC LINE BURIED BELOW." Tape shall be Detectable Identoline by Brady, or equal.
- O. The Contractor shall perform all earthwork including excavation, backfill, bedding, compaction, shoring and bracing, grading and restoration of surfaces and seeded areas disturbed during the execution of the work.

3.04 ELECTRIC HANDHOLES

- A. Electric handholes shall be installed to a sufficient depth to accommodate the required grading of ducts as well as maintaining a minimum distance of 9" from the bottom of the lowest duct centerline entrances to finished floor line and/or highest duct centerline entrance to roof. All handholes shall be built on, or placed over a 6" layer of well-tamped gravel.
- B. Duct envelopes and conduit with bell ends shall enter at approximately right angles to the walls, except as may otherwise be shown on the Drawings.
- C. All fully assembled handholes shall be completely watertight.
- D. All individual cables and/or bundles of conductors shall be identified and "dressed" along the wall of the enclosure. Cable racks as specified herein shall be provided if any handhole dimension exceeds 24 inches.

3.05 TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:
 - 1. Field tests
 - a. Field tests for all completed duct systems shall consist of pulling a swab through each conduit followed by a mandrel equal in size to 85% of the conduit inside diameter.
 - b. After testing, all conduits shall be capped after installation of a suitable pull rope. All field tests shall be witnessed by the Engineer.

- END OF SECTION -

SECTION 16123 - LOW VOLTAGE WIRE AND CABLE

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, install, connect, test, and place in satisfactory operating condition, all low voltage wire and cable indicated on the Drawings and as specified herein and/or required for proper operation. The work of connecting cables to equipment and devices shall be considered a part of this Section. All appurtenances required for the installation of cable and wire systems shall be furnished and installed by the Contractor.
- B. The scope of this Section does not include internal wiring factory installed by electrical equipment manufacturers.
- C. Reference Sections entitled "Basic Electrical Requirements"; "Conduit"; "Underground Electrical"; and "Boxes".

1.02 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall obtain from the wire and cable manufacturer and submit the following:
 - 1. Shop Drawings
 - 2. Reports of Field Tests
 - 3. Wiring Identification Methods
- B. Each submittal shall be identified by the applicable specification section.

1.03 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed material's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible Submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
 - 1. Product data sheets.
 - 2. Cable pulling calculations (if required).
 - 3. Wiring identification methods and materials.

1.04 IDENTIFICATION

- A. Each cable shall be identified as specified in Part 3, Execution, of this Specification.

1.05 CABLE PULLING CALCULATIONS

- A. The Contractor shall submit cable pulling calculations. These calculations, to be performed by a currently registered professional engineer in the State of Florida, shall define pulling tension and sidewall loading (sidewall bearing pressure values) for all installations of 600VAC, #1/0 conductors and larger greater than 200 feet in length. Calculations for straight horizontal installations of 600VAC, #1/0 conductors and larger greater than 200 feet are not required.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

- A. The wire and cable to be furnished and installed for this project shall be the product of manufacturers who have been in the business of manufacturing wire and cable for a minimum of ten (10) years. Wire and cable shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as specified herein and indicated on the Drawings. Only one (1) manufacturer for each wire and cable type shall be permitted.
- B. The wire and cable manufacturer shall be ISO 9000 registered.

2.02 POWER WIRE AND CABLE

- A. Power cable and wire shall consist of stranded, copper conductor with insulation type THHN, 90°C for dry locations and THWN, 75°C for wet locations.
- B. Conductors shall be stranded copper per ASTM-B8 and B-3, and Class B or C stranding contingent on the size unless otherwise specified. Minimum size wire shall be No. 12 AWG.
- C. Multi-conductor power cable assemblies shall be UL 1277 Listed, provided with a bonding conductor, and furnished with an overall PVC jacket.
- D. Power wire and cable shall be as manufactured by the Okonite Company, the Southwire Company, General Cable, or equal.

2.03 CONTROL CABLE

- A. 600 volt control cable shall consist of stranded, copper conductor with insulation type THHN, 90°C for dry locations and THWN, 75°C for wet locations, and 600V.
- B. Conductors shall be stranded copper per ASTM B-8 and B-3, and Class B or C stranding contingent on the size unless otherwise specified. Minimum wire size shall be No. 14 AWG.

- C. Multi-conductor control cable assemblies shall be UL 1277 Listed, provided with a bonding conductor, and furnished with an overall PVC jacket.
- D. Control cable shall be as manufactured by the Okonite Company, the Southwire Company, General Cable, or equal.

2.04 LIGHTING AND RECEPTACLE WIRE

- A. The lighting and receptacle branch circuit wire shall consist of solid, copper conductors with insulation type THHN, 90°C for dry locations and THWN, 75°C for wet locations.
- B. Conductors shall be solid copper per ASTM- B-3. Minimum size wire shall be No. 12 AWG.
- C. Lighting and receptacle wire shall be as manufactured by the Okonite Company, the Southwire Company, General Cable, or equal.

2.05 INSTRUMENTATION CABLE

- A. The instrumentation cable for analog signals shall be single, shielded, twisted pairs or triads with 600 volt insulation and shall have a 75°C (minimum) insulation rating.
- B. Conductors shall be tin, soft, annealed copper, stranded per ASTM-B8, Class B stranding unless otherwise specified. Minimum size wire shall be No. 16 AWG.
- C. The instrumentation cable shall be Okoseal-N Type P-OS for single pair or triad applications and Okoseal-N Type SP-OS for multiple pair or triad applications as manufactured by the Okonite Company, Belden equivalent, Southwire Company equivalent, or equal.

2.06 CONDUCTOR IDENTIFICATION

- A. Conductors shall be identified using a color coding method. Color coding for individual power, control, lighting, and receptacle conductors shall be as follows:

- 1. 480/277V AC Power

- Phase A - BROWN
 - Phase B - ORANGE
 - Phase C - YELLOW
 - Neutral – GREY

- 2. 120/208V or 120/240V AC Power

- Phase A - BLACK
 - Phase B - RED
 - Phase C - BLUE
 - Neutral - WHITE

- 3. DC Power

Positive Lead - RED
Negative Lead - BLACK

4. DC Control

All wiring - BLUE

5. 120VAC Control

120 VAC control wire shall be RED except for a wire entering a motor control center compartment or control panel which is an interlock. This interlock conductor shall be color coded YELLOW.

6. 24VAC Control

All wiring - ORANGE

7. Equipment Grounding Conductor

All wiring - GREEN

- B. Individual conductors No. 2 AWG and smaller shall have factory color coded insulation. It is acceptable for individual conductors larger than No.2 AWG to be provided with factory color coded insulation as well, but it is not required. Individual conductors larger than No.2 AWG that are not provided with factory color coded insulation shall be identified by the use of colored tape in accordance with the requirements listed in Part 3 herein. Insulation colors and tape colors shall be in accordance with the color coding requirements listed above.
- C. Conductors that are a part of multi-conductor control cable assemblies shall have black insulation. The conductor number shall be printed on each conductor's insulation in accordance with ICEA S-58-679, Method 4. Each conductor within the cable assembly shall also be identified with a heat shrink tag with color coded background in accordance with the requirements listed in Part 3 herein. Background color shall be in accordance with the color coding requirements listed above.
- D. Conductors that are a part of multi-conductor power cable assemblies shall have black insulation. The conductor number shall be printed on each conductor's insulation in accordance with ICEA S-58-679, Method 4. Each conductor No.2 AWG and smaller within the cable assembly shall also be identified with a heat shrink tag with color coded background. Each conductor larger than No.2 AWG within the cable assembly shall also be identified by the use of colored tape. Heat shrink tags and colored tape shall be in accordance with the requirements listed in Part 3 herein. Tape color and heat shrink tag background color shall be in accordance with the color coding requirements listed above.

2.07 CABLE PULLING LUBRICANTS

- A. Cable pulling lubricants shall be non-hardening type and approved for use on the type of cable installed. Lubricant shall be Yellow #77 Plus by Ideal, Cable Gel by Greenlee, Poly-Gel by Gardner Bender, or equal.

PART 3 -- EXECUTION

3.01 POWER, CONTROL, AND LIGHTING/RECEPTACLE WIRE AND CABLE INSTALLATION

- A. The wire and cable shall be installed as specified herein and indicated on the Drawings.
- B. The cables shall be terminated in accordance with the cable and/or termination product manufacturer's instructions for the particular type of cable.
- C. To minimize oxidation and corrosion, wire and cable shall be terminated using an oxide-inhibiting joint compound recommended for "copper-to-copper" connections. The compound shall be Penetrox E as manufactured by Burndy Electrical, or equal.
- D. Splices shall not be allowed in the underground handhole systems, except where required by the Electric Utility. If splices are required for any other purpose, the Contractor shall obtain approval in writing from the Engineer prior to splicing. Splicing materials shall be barrel type butt splice connectors and heat shrink tubing as manufactured by 3M, Ideal, or equal. No splicing of instrumentation cable is allowed. The use of screw-on wire connectors (wire nuts) shall only be permitted for lighting and receptacle circuits.
- E. Wire and Cable Sizes
 - 1. The sizes of wire and cable shall be as indicated on the Drawings, or if not shown, as approved by the Engineer. If required due to field routing, the size of conductors and respective conduit shall be increased so that the voltage drop measured from source to load does not exceed 2-1/2%.
- F. Additional Conductor Identification
 - 1. In addition to the color coding identification requirements specified in Part 2 herein, individual conductors shall be provided with heat shrinkable identification tags. Identification tags for individual conductors shall have a white background where the conductor insulation is colored. Identification tags for individual conductors shall have a colored background where the conductor insulation is black. Background color shall match that of the taping provided on the individual black conductors.
 - 2. Multi-conductor cables shall be provided with heat shrinkable identification tags in accordance with Part 2 herein.
 - 3. All wiring shall be identified at each point of termination. This includes but is not limited to identification at the source, load, and in any intermediate junction boxes where a termination is made. The Contractor shall meet with the Owner and Engineer to come to an agreement regarding a wire identification system prior to installation of any wiring. Wire numbers shall not be duplicated.
 - 4. Wire identification shall be by means of a heat shrinkable sleeve with appropriately colored background and black text. Wire sizes #14 AWG through #10 AWG shall have a minimum text size of 7 points. Wire sizes #8 AWG and larger shall have a minimum text size of 10 points. Sleeves shall be of appropriate length to fit the

required text. The use of handwritten text for wire identification shall not be permitted.

5. Sleeves shall be suitable for the size of wire on which they are installed. Sleeves shall not be heat-shrunk onto control cables. Tags shall remain loose on cable to promote easier identification. For all other applications, sleeves shall be tightly affixed to the wire and shall not move. Sleeves shall be heat shrunk onto wiring with a heat gun approved for the application. Sleeves shall not be heated by any means which employs the use of an open flame. The Contractor shall take special care to ensure that the wiring insulation is not damaged during the heating process.
6. Sleeves shall be installed prior to the completion of the wiring terminations and shall be oriented so that they can be easily read.
7. Sleeves shall be polyolefin as manufactured by Brady, Seton, Panduit, or equal.
8. Wire identification in handholes, pull boxes, and other accessible components in the raceway system where the wiring is continuous (no terminations are made) shall be accomplished by means of a tag installed around the bundled group of individual conductors or around the outer conductor jacket of a multi-conductor cable. Identification shall utilize a FROM-TO system. Each group of conductors shall consist of all of the individual conductors in a single conduit or duct. The tag shall have text that identifies the bundle in accordance with the 'FROM' and 'TO' column for that particular conduit number in the conduit and wire schedule. Minimum text size shall be 10 point. The tag shall be affixed to the wire bundle by the use of nylon wire ties, and shall be made of polyethylene as manufactured by Brady, Seton, Panduit, or equal.
9. Where colored tape is used to identify cables, it shall be wrapped around the cable with a 25% overlap and shall cover at least 2 inches of the cable.

H. Wiring Supplies

1. Only electrical wiring supplies manufactured under high standards of production and meeting the approval of the Engineer shall be used.
2. Rubber insulating tape shall be in accordance with ASTM Des. D119. Friction tape shall be in accordance with ASTM Des. D69.

I. Training of Cable

1. The Contractor shall furnish all labor and material required to train cables handholes in the outdoor underground duct system. Sufficient length of cable shall be provided in each handhole so that the cable can be trained and racked in an approved manner. In training or racking, the radius of bend of any cable shall be not less than the manufacturer's recommendation. The training shall be done in such a manner as to minimize chaffing. Reference Section entitled "Underground Electrical."
2. Instrumentation cable shall be racked separate from other AC and DC wiring to maintain the required separation as follows:

- a. 18 inches for 480/277VAC wiring
- b. 12 inches for 208/120VAC wiring
- c. 6 inches for 24VDC wiring

J. Conductor Terminations

- 1. Where wires are terminated at equipment which requires lugs, connections shall be made by solderless mechanical lug, crimp type ferrule, or irreversible compression type lugs. Reference individual equipment specification sections as applicable for additional termination requirements.
- 2. Where enclosure sizes and sizes of terminals at limit switches, solenoid valves, float switches, pressure switches, temperature switches, and other devices make terminations impractical due to the size of the field wiring, the Contractor shall terminate field wiring in an adjacent junction per the requirements of Section entitled "Boxes," complete with terminal strips. Contractor shall install the smaller wiring from the device to the junction box in a conduit, using the terminal strip as the means for joining the two different wire sizes. Splicing of wires in lieu of using terminal strips is not acceptable.
- 3. All spare conductors shall be terminated on terminal blocks mounted within equipment or junction boxes. Unless otherwise noted, coiling up of spare conductors within enclosure is not acceptable.

K. Pulling Temperature

- 1. Cable shall not be flexed or pulled when the temperature of the jacket is such that damage will occur due to low temperature embrittlement. When cable will be pulled with an ambient temperature of 40°F or less within a three (3) day period prior to pulling, the cable reels shall be stored three (3) days prior to pulling in a protected storage area with an ambient temperature of 55°F or more. Cable pulling shall be completed during the work day for which the cable is removed from the protected storage. Any remaining cable reels shall be returned to storage at the completion of the workday.

3.02 INSTRUMENTATION CABLE INSTALLATION

- A. The Contractor shall install all cable or conductors used for instrumentation wiring (4-20 mA DC, etc.) in conduit as specified in Section entitled "Conduit." Only instrumentation cable as specified herein shall exclusively occupy these conduits. No other wiring for AC or discrete DC circuits shall be installed in these conduits.
- B. All shielding shall be continuous and shall be **grounded at one point only**.
- C. Where instrumentation cables are installed in panels, handholes, and other locations, the Contractor shall arrange wiring to provide maximum clearance between these cables and other conductors. Instrumentation cables shall not be installed in same bundle with conductors of other circuits.

- D. Special instrument cable shall be as specified or recommended by the manufacturer of the equipment or instruments requiring such wiring. Installation, storage, and terminations, shall be per manufacturer's recommendations.

3.03 TESTING

- A. All testing shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:

- 1. Shop Test

- a. Cable and wiring shall be tested in accordance with the applicable ICEA Standards. Wire and cable shall be physically and electrically tested in accordance with the manufacturer's standards.

- 2. Field Tests

- a. After installation, all wires and cables shall be tested for continuity. Testing for continuity shall be "test light" or "buzzer" style.
 - b. After installation, some wires and cables shall be tested for insulation levels. Insulation resistance between conductors of the same circuit and between conductor and ground shall be tested. Testing for insulation levels shall be as follows:

- (1) For #8 AWG and larger 600V power and control cable, apply 1,000 VDC from a Megaohmmeter for one (1) minute for all 600V wires and cables installed in lighting, control, power, indication, alarm and motor feeder circuits. Resistance shall be no less than 100 Megaohms. Insulation testing is not required for power and control cables smaller than #8 AWG.
 - (2) 600V instrumentation signal cable shall be tested from conductor to conductor, conductor to shield, and conductor to ground using a Simpson No. 260 volt-ohmmeter, or approved equal. The resistance value shall be 200 Megaohms or greater.

- B. Wires and cables shall be tested before being connected to motors, devices or terminal blocks.
- C. If tests reveal defects or deficiencies, the Contractor shall make the necessary repairs or shall replace the cable as directed by the Engineer, without additional cost to the Owner.
- D. All tests shall be made by and at the expense of the Contractor who shall supply all testing equipment. Test reports shall be submitted to the Engineer.

- END OF SECTION -

(EXHIBIT A) TEST DATA - MEGOHMS TEST NO. ____							
Date:			Company:				
Time:			Location:				
Circuit:	Circuit Length:	Aerial:	Duct:	Buried:	No. of Conductors	Size:	AMG MCM Shld:
Insulation Material:			Insulation Thickness:		Voltage Rating:		Age:
Type: ____Pothead ____Terminal					Location: Indoors____ Outdoors____		
Number and Type of Joints:							
Recent Operating History:							
Manufacturer:							
State if Potheads or Terminals were grounded during test:							
List associated equipment included in test:							
Miscellaneous Information:							

(EXHIBIT A) TEST DATA - MEGOHMS TEST NO. _____							
Part Tested: Test Made: _____ Hours/Days: _____ After Shutdown: _____							
Grounding Time: Dry Bulb Temperature: _____ Wet Bulb Temperature: _____							
Test Voltage: _____				Equipment Temperature: _____ How Obtained: _____ Relative Humidity: _____ Absolute Humidity: _____ Dew Point: _____			
Megohmmeter: Serial Number: _____ Range: _____ Voltage: _____ Calibration Date: _____							
Test Connections	To Line To Earth To Ground	To Line To Earth To Ground	To Line To Earth To Ground	Test Connections	To Line To Earth To Ground	To Line To Earth To Ground	To Line To Earth To Ground
<input type="checkbox"/> Minute				5 Minutes			
<input type="checkbox"/> Minute				6 Minutes			
3/4 Minute				7 Minutes			
1 Minute				8 Minutes			
2 Minutes				9 Minutes			
3 Minutes				10 Minutes			
4 Minutes				10/1 Minutes			
				Ratio			
Remarks:							

SECTION 16130 - BOXES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The scope of work under this Section includes furnishing and installing all pull boxes, junction boxes, and outlet boxes.
- B. Requirements for other boxes and enclosures are not included in this Section. Reference each specific Division 16 equipment Section for requirements related to that equipment's respective enclosure.
- C. Reference Sections entitled "Basic Electrical Requirements," and "Conduit."

1.02 CODES AND STANDARDS

- A. Boxes shall be designed, manufactured, and/or listed to the following standards as applicable:
 - 1. UL 514A - Metallic Outlet Boxes
 - 2. UL 514C - Standard for Non-metallic Outlet Boxes, Flush Device Boxes, and Covers
 - 3. UL 50 – Enclosures for Electrical Equipment, Non-environmental Considerations
 - 4. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations
 - 5. UL 1203 – Standard for Explosion-proof and Dust-ignition-proof Electrical Equipment for use in Hazardous (Classified) Locations.
 - 6. NEMA 250 – Enclosures for Electrical Equipment

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer(s) and submit the following:
 - 1. Shop Drawings
- B. Each submittal shall be identified by the applicable specification section.

1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

- B. Partial, incomplete or illegible Submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
 - 1. Product data sheets for boxes, terminal strips, and all accessories

1.05 OPERATION AND MAINTENANCE MANUALS

- A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 1.
- B. As-built drawings showing dimensions, internal box layout, terminal strip information, and terminal strip identification information shall be provided for all junction boxes. As-built drawings are not required for pull boxes or outlet boxes.

1.06 IDENTIFICATION

- A. Each pull and junction box shall be identified with the box name as indicated on the Contract Drawings or as directed by the Engineer. A nameplate shall be securely affixed in a conspicuous place on each box. Nameplates shall be as specified in Section entitled "Electrical – Identification."

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

- A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

2.02 PULL AND JUNCTION BOXES

A. General

- 1. All pull and junction boxes shall be UL listed and labeled.
- 2. Pull and junction boxes shall not be provided with eccentric or concentric knockouts.
- 3. Pull and junction boxes mounted embedded in concrete shall be UL listed for embedment.
- 4. Where metallic boxes are used they shall be of all welded construction. Tack welded boxes are not acceptable.

B. Pull Boxes

- 1. All pull boxes shall be provided with a matching gasketed cover. For covers with dimensions of 24 inches by 24 inches or less, the cover shall be held in place by

machine screws. Other screw types are not acceptable. For covers with dimensions greater than 24 inches by 24 inches, the cover shall be hinged and held in place by screw-operated clamp mechanisms. Hinge pins shall be removable. Clamp mechanism material of construction shall match that of the associated box.

2. Pull boxes shall not have any wire terminations inside, other than those for grounding/bonding. A ground bar shall be provided with the necessary number of screw type terminals. Twenty (20) percent of the total amount of terminals otherwise required for the pull box (minimum of two) shall be provided as spare terminations. Boxes requiring any other wire terminations shall be furnished and installed in accordance with the requirements for junction boxes herein.
3. Pull boxes shall be 6 inches wide by 6 inches tall by 4 inches deep, minimum. For applications requiring larger boxes, the box shall be sized in accordance with the fill requirements and dimensional requirements of the NEC.
4. Barriers shall be provided in pull boxes to isolate conductors of different voltages, types, and functions. Barrier material of construction shall match that of the box. Isolation shall be provided between the following groups:
 - a. Power wiring
 - b. AC control wiring
 - c. DC control wiring
 - d. Instrumentation wiring

C. Junction Boxes

1. Junction boxes used for lighting and receptacle circuits only shall be provided with a matching gasketed cover held in place by machine screws. Other screw types are not acceptable.
2. Junction boxes for all uses other than lighting and receptacle circuits shall be provided with a hinged, gasketed cover. Hinge pins shall be removable. Cover shall be held in place by screw-operated clamp mechanisms. Clamp mechanism material of construction shall match that of the associated box.
3. Barriers shall be provided in junction boxes to isolate conductors and terminal blocks of different voltages, types, and functions. Barrier material of construction shall match that of the box. Isolation shall be provided between the following groups:
 - a. Power wiring
 - b. AC control wiring
 - c. DC control wiring
 - d. Instrumentation wiring

4. Junction boxes used for lighting and receptacle circuits only shall be allowed to have screw-on (wire nut) type connectors for wire terminations/junctions.
5. Junction boxes for all uses other than lighting and receptacle circuits shall be provided with terminal strips, consisting the necessary number of screw type terminals. Current carrying parts of the terminal blocks shall be of ample capacity to carry the full load current of the circuits connected, with a 10A minimum capacity. Terminal strips shall be rated for the voltage of the circuits connected. A separate ground bar shall be provided with the necessary number of screw type terminals. Twenty (20) percent of the total amount of terminals otherwise required for the junction box (minimum of two) shall be provided as spare terminations. When barriers are provided within the box, separate terminal strips shall be provided in each barrier area. Terminals shall be lettered and/or numbered to conform to the wiring labeling scheme in place on the project.
6. Junction boxes shall be 6 inches wide by 6 inches tall by 4 inches deep, minimum. For applications requiring larger boxes, the box shall be sized in accordance with the fill requirements and dimensional requirements of the NEC. Terminal blocks (including spare terminals) shall be considered when sizing the junction box.

D. Enclosure Types and Materials

1. In non-hazardous locations, pull and junction boxes shall be furnished with the following enclosure type and material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

AREA DESIGNATION	ENCLOSURE TYPE AND MATERIAL
All Outdoor Areas	NEMA 4X, Type 304 Stainless Steel

2.03 OUTLET BOXES

A. General

1. Outlet boxes shall be provided with a trim appropriate for the wiring device installed inside. Reference Section entitled "Wiring Devices," for outlet box trim requirements. An appropriate outlet box trim is required to achieve the NEMA rating of the outlet boxes as specified herein.

B. Surface Mount Outlet Boxes

1. Outlet boxes shall be the deep type, no less than 2.5 inches deep.
2. Outlet boxes shall be provided in single or multi-gang configuration as required, sized in accordance with the requirements of the NEC.
3. In non-hazardous locations, outlet boxes shall be furnished with the following enclosure type and material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

AREA DESIGNATION	ENCLOSURE TYPE AND MATERIAL
All Outdoor Areas	NEMA 4X, PVC Coated Steel

4. Outlet boxes shall be provided with integral threaded conduit hubs mounted external to the box. Boxes with threaded conduit hubs mounted internal to the box or as a part of the box wall are not acceptable.

C. Flush Mount Outlet Boxes

1. Outlet boxes shall be no less than 2-1/8 inches deep, and 4-11/16 inches square. Boxes shall be UL listed and labeled. Pre-punched single diameter conduit knockouts are acceptable, however, concentric and eccentric knockouts are not acceptable.
2. Outlet boxes mounted cast into concrete shall be concrete tight, and shall be made of PVC-coated galvanized steel or PVC.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Pull and Junction Boxes

1. Pull boxes and junction boxes shall be solidly attached to structural members prior to installation of conduit and set true and plumb. Boxes shall not be supported by their associated conduits.
2. Wooden plugs are not permitted for securing boxes to concrete. Appropriately rated anchors specifically suited for use in concrete shall be used.
3. Box penetrations for conduits shall be made with a punch tool, and penetrations shall be of the size required for the conduit entry and/or hub. Oversized penetrations in boxes are not acceptable.
4. Watertight conduit hubs shall be provided for boxes where a NEMA 4X enclosure rating is specified. Reference Section "Conduit," for conduit hub requirements.
5. Pull and junction boxes may be installed flush mounted in gypsum, concrete or CMU walls where appropriate provided that covers are easily removed or opened.
6. Pull and junction boxes shall be provided in the enclosure type and material of construction required for the area in which it is installed. Reference the requirements in Part 2 herein, and the area designations indicated on the Drawings.

B. Outlet Boxes

1. Outlet boxes shall be solidly attached to structural members prior to installation of conduit and set true and plumb. Boxes shall not be supported by their associated conduits.

2. Wooden plugs are not permitted for securing boxes to concrete. Appropriately rated anchors specifically suited for use in concrete shall be used.
3. Flush mounted outlet boxes shall be arranged and located so that tile and grout lines fit closely around the boxes, and so placed that the cover or device plate shall fit flush to the finished wall surface.
4. Outlet boxes shall be flush mounted in finished areas and other areas where practical. Flush mounted outlet boxes shall not be installed in hazardous areas and type 1 or 2 chemical storage/transfer areas.
5. For the below-named items, mounting heights from finished floor, or finished grade to top is applicable, depending on the type of wiring device to be installed in the outlet box. Mounting heights for outlet boxes shall be as follows, unless otherwise specified herein, indicated on the Drawings, or required by the Americans with Disability Act (ADA):
 - a. Light switches and wall mounted occupancy sensors, 48 inches
 - b. Receptacles in outdoor locations, 24 inches
6. Outlet boxes shall be provided in the material of construction required for the area in which it is installed. Reference the requirements in Part 2 herein, and the area designations indicated on the Drawings.

- END OF SECTION -

SECTION 16141 - WIRING DEVICES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install all switches and receptacles of the type and at the locations as shown on the Drawings.
- B. All switches and receptacles shall be furnished and installed in outlet boxes. Reference Section entitled "Boxes," for outlet box requirements.
- C. Reference Sections entitled "Basic Electrical Requirements" and "Low Voltage Wire and Cable."

1.02 CODES AND STANDARDS

- A. Wiring devices shall be designed, manufactured, and/or listed to the following standards as applicable:
 - 1. UL 20 – General Use Snap Switches
 - 2. UL 498 – Standard for Attachment Plugs and Receptacles
 - 3. UL 943 – Ground Fault Circuit Interrupters

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section entitled "Submittals," the Contractor shall obtain from the equipment manufacturer and submit shop drawings. Each submittal shall be identified by the applicable specification section.

1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include, but not be limited to:
 - 1. Product data sheets.

1.06 IDENTIFICATION

- A. Each switch and receptacle shall be identified with the equipment item number, manufacturer's name or trademark, and such other information as the manufacturer may consider necessary, or as specified, for complete identification.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

- A. The equipment covered by these Specifications is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.
- B. The Contractor shall use the products of a single manufacturer for each type of wiring device.
- C. The Contractor shall use the products of a single manufacturer for all device plates. Plate variations are allowed for the following devices:
 - 1. Where the selected plate manufacturer does not manufacture a suitable finish plate.
 - 2. For heavy-duty receptacles rated at more than 30A.
 - 3. Where non-standard plates are required, specified, or shown.
- D. The Contractor shall furnish and install all wiring devices and device plates.
- E. In non-hazardous areas, provide specification grade devices manufactured by Appleton, Crouse-Hinds, Leviton, Hubbell, Pass & Seymour, or Engineer approved equal.

2.02 WIRING DEVICES

- A. Wall switches for non-hazardous areas shall be rated for the current required to suit the application, but not less than 20A. Double pole, three-way, and four-way switches shall be provided where indicated on the Drawings, and as required. Switches shall be rated for 120-277VAC, and shall be UL 20 Listed.
- B. Convenience receptacles for non-hazardous areas shall be rated for 20A at 125VAC. Convenience receptacles shall be UL 498 Listed. Tamper resistant receptacles are not acceptable.
- C. Ground fault circuit interrupter receptacles shall be rated for 20A at 125VAC. Ground fault circuit interrupter receptacles shall be UL 943 Listed. Tamper resistant receptacles are not acceptable.
- D. All wiring devices shall be approved for use with stranded conductors, if stranded conductors are to be used with the device. Reference Section entitled "Low Voltage Wire and Cable" for conductor requirements

2.03 DEVICE PLATES

- A. Device plates for indoor flush-mounted receptacles and switches shall be made of Type 304 stainless steel, not less than 0.032 of an inch thick, with beveled edges and milled on the rear so as to lie flat against the wall. Devices plates shall be provided with a gasket.
- B. Device plates for outdoor installations, indoor wet process areas shall be Appleton Type FSK, Crouse-Hinds #DS185, or equal for wall switches. Device plates for receptacles shall be "in-use" style. "In-use" weatherproof covers shall be rugged, minimum 3 ¼" depth, die-cast aluminum as manufactured by Thomas & Betts "Red Dot," Intermatic International, Inc., or equal.

2.04 PLUGS

- A. The Contractor shall furnish suitable plugs with equipment furnished under the respective specification Section. Plugs shall be black rubber or plastic. For waterproof receptacles, the plugs shall be similar in construction to the receptacles and shall be encased in corrosion resistant yellow housing provided with clamping nuts and stuffing gland cable outlets.

2.05 PROCESS INSTRUMENTS

- A. The Contractor shall furnish and install a local disconnect switch at each process instrument (e.g., level transmitter, flow transmitter, analytical instrument etc.,) to disconnect the 120VAC power supply to the instrument. The device shall be a NSSC series manual motor starting switch without overload protection as manufactured by Crouse-Hinds, Appleton equivalent, or equal.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. Where more than one (1) switch occurs at one (1) location, gang plates shall be used.
- B. All device plates shall be set true and plumb, and shall fit tightly against the finished wall surfaces and outlet boxes.
- C. Wiring device box (outlet box) mounting heights shall be as specified in Section entitled "Boxes."
- D. When indicated height would place any of the equipment at an unsuitable location such as at a molding or break in wall finish, the Contractor shall bring it to the attention of the Engineer for a decision.
- E. For outdoor applications, all receptacles shall be ground fault circuit interrupter type. Furnish and install ground fault circuit interrupter receptacles at additional locations where indicated on the Drawings, and as required by the NEC.
- F. All receptacles shall have a self-adhesive label installed on the top at the respective device plate that indicates which panel and which circuit number the receptacle is supplied from. Labels shall have a white background and black lettering in 14 point font.

3.02 CIRCUITING

- A. Convenience receptacles shall be grouped on circuits separate from the lighting circuits. A maximum of eight (8) convenience receptacles are permitted per 20A, 120V circuit, unless otherwise indicated on the Drawings.

- END OF SECTION -

SECTION 16170 - GROUNDING AND BONDING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install grounding systems complete in accordance with the minimum requirements established by Article 250 of the NEC. Article 250 of the NEC shall be considered a minimum requirement for compliance with this Specification.
- B. Grounding of all instrumentation and control systems shall be furnished and installed in accordance with the manufacturer/system requirements and IEEE 1100-92, Powering and Grounding of Sensitive Electronic Equipment. Conflicts shall be promptly brought to the attention of the Engineer.
- D. Reference Section entitled "Basic Electrical Requirements."

1.02 CODES AND STANDARDS

- A. Equipment and materials covered under this Section shall be designed, manufactured, and/or listed to the following standards as applicable:
 - 1. UL 467 – Grounding and Bonding Equipment
 - 2. IEEE 81 – Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section entitled "Submittals," the Contractor shall obtain from the equipment manufacturer and submit the following:
 - 1. Shop Drawings
 - 2. Reports of certified field tests.
- B. Each submittal shall be identified by the applicable specification section.

1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:

1. Product data sheets.
2. Drawings and written description of how the Contractor intends to furnish and install the grounding system.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

- A. The equipment covered by these specifications shall be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

2.02 GROUND RODS AND GRID

- A. Ground rods shall be rolled to a commercially round shape from a welded copper-clad steel manufactured by the molten-welding process or by the electro-formed process (molecularly bonded). They shall have an ultimate tensile strength of 75,000 pounds per square inch (psi) and an elastic limit of 49,000 psi. The rods shall be not less than 3/4 inch in diameter by 10 feet in length; and the proportion of copper shall be uniform throughout the length of the rod. The copper shall have a minimum wall thickness of 0.010 inch at any point on the rod. Ground rods shall be UL 467 listed. The ground rods shall be manufactured by Erico Products, Blackburn, or equal.
- B. Except where specifically indicated otherwise, all exposed non current-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductors in nonmetallic raceways and neutral conductors of wiring systems shall be grounded.
- C. The ground connection shall be made at the main service equipment and shall be extended to the ground grid surrounding the structure. The ground grid shall also be connected to the point of entrance of the metallic water service. Connection to the water pipe shall be made by a suitable ground clamp or lug connection to a plugged tee. If flanged pipes are encountered, connection shall be made with the lug bolted to the street side of the flanged connection.
- D. Where ground fault protection is employed, care shall be taken so that the connection of the ground and neutral does not interfere with the correct operation of the ground fault protection system.

2.03 FITTINGS

- A. Grounding connections to equipment shall be bolted. Cable end connections shall be made by hydraulic crimp or exothermically welded. Split bolt type connectors are not acceptable. Fittings shall be UL 467 listed.

2.04 EQUIPMENT GROUNDING CONDUCTORS

- A. An insulated equipment grounding conductor, which shall be separate from the electrical system neutral conductor, shall be furnished and installed for all circuits. Insulation shall be of the same type as the underground conductors in the raceway and shall be green in color. Equipment grounding conductors shall be furnished and installed in all conduits. Use of conduits as the NEC required equipment grounding conductor is not acceptable.

2.05 EXOTHERMIC WELDS

- A. All exothermic welding shall be completed per welding kit manufacturer's instructions. Exothermic welds shall be CadWeld by Erico or ThermoWeld.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. Metal surfaces where grounding connections are to be made shall be clean and dry. Steel surfaces shall be ground or filed to remove all scale, rust, grease, and dirt. Copper and galvanized steel shall be cleaned with emery cloth to remove oxide before making connections.
- B. Ground Grid
 - 1. A main ground grid shall be provided for each structure and interconnecting structure grids consisting of driven ground rods as shown on the Drawings. The ground rods shall be interconnected by the use of copper cable exothermically welded to the rods. The grounding cables shall be installed after the excavations for the building have been completed and prior to the pouring of concrete for the footings, mats, etc. Copper "pigtails" shall be connected to the ground grid and shall enter the buildings and structure from the outside and shall be connected to steel structures, and equipment as described in this Section, as shown on the drawings, and as required to provide a complete grounding system. The copper pigtailed shall be exothermically welded to the ground grid, and connected to building reinforcement steel by hydraulic crimp.
 - 2. Grounding conductors shall be continuous between points of connection; splices shall not be permitted.
 - 3. Where conductors are exposed and subject to damage from personnel, traffic, etc., conductors shall be installed in metal raceway. The raceway shall be bonded to the grounding system.
 - 4. Where subsurface conditions do not permit use of driven ground rods to obtain proper ground resistance, rods shall be installed in a trench or plate electrodes shall be provided, as applicable and necessary to obtain proper values of resistance.
 - 5. Buried exothermic welds and ground ring shall not be backfilled until inspected by Engineer.

C. Raceways

1. Conduit which enters equipment such as transformers, instrument and control panels, and similar equipment shall be bonded to the ground bus or ground lug, where provided, and as otherwise required by the NEC.

3.02 TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:

1. Witnessed Shop Tests

- a. None required.

2. Field Tests

- a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 1, and NETA Acceptance Testing Specifications, latest edition.
- b. Fall of potential tests shall be performed on the ground grid per IEEE81 recommendations by a third party, independent testing firm. A fall of potential plot shall be submitted at the conclusion of testing for Engineer review. Documentation indicating the location of the rod and grounding system as well as the resistance and soil conditions at the time the measurements were made shall be submitted. Testing shall show that the ground grid has 5 ohms resistance or less. Due to soil conditions and/or unforeseen field conditions, ground resistances greater than 5 ohms may be acceptable if specifically approved in writing by the Engineer. Ground resistance measurements shall be made in normally dry weather not less than 48 hours after rainfall and with the ground grid under test isolated from other grounds.
- c. Continuity tests for the grounding electrode conductor shall also be performed. Test will be accepted when a resistance of less than 1 ohm is shown for this conductor.

- END OF SECTION -

SECTION 16190 - SUPPORTING DEVICES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install structural supports for mounting and installing all conduit, electrical equipment, lighting, alarm systems, instrumentation, and communications equipment furnished under this Contract.
- B. Equipment shall be installed strictly in accordance with recommendations of the manufacturer and best practices of the trade resulting in a complete, operable, and safe installation. The Contractor shall obtain written installation manuals from the equipment manufacturer prior to installation.
- C. Reference Section entitled "Basic Electrical Requirements."

1.02 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section entitled "Submittals," the Contractor shall obtain from the equipment manufacturer and submit the following:
 - 1. Shop drawings
 - 2. Structural support calculations (if required)
- B. Each submittal shall be identified by the applicable Specification section.

1.03 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
 - 1. Product data sheets.
 - 2. Complete assembly, layout, installation, and foundation drawings with clearly marked dimensions.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

- A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

2.02 MATERIALS

- A. Support channel shall be 1-5/8" by 1-5/8" minimum, with 12 gage material thickness, unless otherwise indicated.
- B. Support channel, support channel fittings, and threaded rod shall be furnished with the following material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

AREA DESIGNATION	MATERIAL OF CONSTRUCTION
All Outdoor Areas	Type 304 Stainless Steel

- C. Fastening hardware (bolts, nuts, washers, and screws) shall be furnished with the following material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

AREA DESIGNATION	MATERIAL OF CONSTRUCTION
All Outdoor Areas	Type 316 Stainless Steel

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. Concrete or Masonry Inserts
 - 1. The Contractor shall be responsible for the furnishing and installation of all conduit sleeves, anchor bolts, masonry inserts, and similar devices required for installation of equipment furnished under this Contract.
 - 2. If a time delay for the arrival of any special inserts or equipment drawings, etc. occurs, the Contractor may, if permitted by the Engineer, make arrangements for providing approved recesses and openings in the concrete or masonry and, upon subsequent installation, the Contractor shall be responsible for filling in such recesses and openings. Any additional costs that may be incurred by this procedure shall be borne by the Contractor.
 - 3. The Contractor shall furnish leveling channels for all switchgear, switchboards, motor control centers, and similar floor mounted equipment. The leveling channels shall be provided for embedment in the equipment housekeeping pads. Coordination of the installation of these channels with the concrete pad is essential and required. Pad

height shall be as required to maintain concrete coverage of the reinforcement bars while not causing associated equipment to exceed the maximum mounting height requirements of the NEC.

B. Support Fastening and Locations

1. All equipment fastenings to columns, steel beams, and trusses shall be by beam clamps or welded. No holes shall be drilled in the steel.
2. Support channel shall be provided wherever required for the support of starters, switches, panels, and miscellaneous equipment.
4. All supports shall be rigidly bolted together and braced to make a substantial supporting framework. Where possible, control equipment shall be grouped together and mounted on a single framework.
7. Actual designs for supporting framework should take the nature of a picture frame of support channels and bracket with a plate for mounting the components. The Contractor is responsible for the design of supporting structure; he shall submit design details to the Engineer for acceptance before proceeding with the fabrication.
8. Wherever dissimilar metals come into contact, the Contractor shall isolate these metals as required with neoprene washers, nine (9) mil polyethylene tape, or gaskets.
10. For the following installations where conduits are provided with a support system suspended from the above or attached to a vertical structure, the Contractor shall submit structural calculations and details of the proposed system of support. Structural calculations shall be signed and sealed by a registered professional engineer in the State of Florida.
 - a. A quantity of twelve (12) or more conduits trade size 1" and smaller are proposed for a conduit support rack.
 - b. A quantity of eight (8) or more conduits trade sizes 1 1/2" to 2 1/2" are proposed for a conduit support rack.
 - c. A quantity of four (4) or more conduits trade sizes 3" and larger are proposed for a conduit support rack.

- END OF SECTION -

SECTION 16195 - ELECTRICAL - IDENTIFICATION

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. All electrical equipment shall be properly identified in accordance with these Specifications and the Contract Drawings. Control panels, pull and junction boxes, enclosures, disconnect switches, control stations, and similar equipment shall be identified in the manner described, or in an equally approved manner.
- B. The types of electrical identification specified in this section include, but are not limited to, the following:
 - 1. Operational instructions and warnings.
 - 2. Danger signs.
 - 3. Equipment/system identification signs.
 - 4. Nameplates.

1.02 LETTERING AND GRAPHICS

- A. The Contractor shall coordinate names, abbreviations, and other designations used in the electrical identification work with the corresponding designations shown, specified or scheduled. Provide numbers, lettering, and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of the electrical systems and equipment.

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section entitled "Submittals," the Contractor shall obtain from the equipment manufacturer and submit shop drawings. Each submittal shall be identified by the applicable specification section.

1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
 - 1. Product data sheets.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

- A. The material covered by these Specifications is intended to be standard material of proven performance as manufactured by reputable concerns. Material shall be fabricated, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as specified herein and shown on the Drawings.

2.02 NAMEPLATES

- A. Nameplates shall be engraved, high pressure plastic laminate, white with black lettering.
- B. Nameplates shall be attached to NEMA 4X enclosures utilizing UL-recognized mounting kits designed to maintain the overall UL Type rating of the enclosure. Mounting kit fasteners shall be stainless steel Type AHK10324X as manufactured by Hoffman, or equal.

2.03 HIGH VOLTAGE SIGNS

- A. Standard "DANGER" signs shall be of baked enamel finish on 20 gage steel; of standard red, black and white graphics; 14 inches by 10 inches size except where 10 inches by 7 inches is the largest size which can be applied where needed, and except where a larger size is needed for adequate identification.

2.04 CONDUIT IDENTIFICATION

- A. Conduit identification shall be as specified in Section entitled "Conduit."

2.05 WIRE AND CABLE IDENTIFICATION

- A. Field installed wire and cable identification shall be as specified in Section entitled "Low Voltage Wire and Cable."
- B. Wiring identification for factory installed wiring in equipment enclosures shall be as specified in the respective section.

2.06 BOX IDENTIFICATION

- A. Pull, junction and device box identification shall be as specified in Section entitled "Boxes."

PART 3 -- EXECUTION

3.01 NAMEPLATES

- A. Nameplates shall be attached to the equipment enclosures with (2) two stainless steel sheet metal screws for nameplates up to 2-inches wide. For nameplates over 2-inches wide, four (4) stainless steel sheet metal screws shall be used, one (1) in each corner of the nameplate. The utilization of adhesives is not permitted.

3.02 OPERATIONAL IDENTIFICATION AND WARNINGS

- A. Wherever reasonably required to ensure safe and efficient operation and maintenance of the electrical systems and electrically connected mechanical systems and general systems and equipment, including prevention of misuse of electrical facilities by unauthorized personnel, install plastic signs or similar equivalent identification, instruction, or warnings on switches, outlets, and other controls, devices, and covers or electrical enclosures. Where detailed instructions or explanations are needed, provide plasticized tags with clearly written messages adequate for the intended purposes. Signs shall be attached as specified above for nameplates.

3.03 POWER SOURCE IDENTIFICATION

- A. After installation of all field equipment (i.e. valves, motors, fans, unit heaters, instruments, etc) install nameplates at each power termination for the field equipment. Nameplate data shall include equipment designation (tag number), power source (MCC number, panelboard, etc), circuit number, conduit number from schedule and voltage/phase.
- B. Contractor to coordinate with the Engineer and the Owner regarding exact nameplate placement during construction.
- C. Nameplates shall be as specified herein.

- END OF SECTION -

SECTION 16280 - SURGE PROTECTIVE DEVICES

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, install, and place in satisfactory operation, the surge protective devices (SPD) as specified herein and indicated on the Drawings.
- B. The surge protective devices specified under this Section shall be provided as a stand-alone unit, separate from the enclosure of the equipment to which they are connected. The requirements of this Section shall not apply to equipment where an integral SPD is specified.
- C. Reference Section entitled "Low Voltage Wire and Cable."

1.02 CODES AND STANDARDS

- A. The surge protective device shall be designed, manufactured, and listed to the following standards:
 - 1. Underwriters Laboratories, Inc. (UL)
 - a. UL1449, latest edition: Surge Protective Devices
 - b. UL1283, latest edition: Electromagnetic Interference Filters
 - 2. American National Standards Institute (ANSI)/Institute of Electrical & Electronic Engineers (IEEE)
 - a. C62.41.1: 2002 Guide for Surge Voltages in Low-Voltage AC Power Circuits
 - b. C62.41.2: 2002 Recommend Practice on Characterization of Surges in Low Voltage (100V and Less) AC Power Circuits.
 - c. C62.45: 2002 IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000V and Less) AC Power Circuits
 - d. C62.62: 2000 IEEE Standard Test Specifications for Surge Protective Devices for Low Voltage (1000V and Less) AC Power Circuits
 - 3. National Electric Code (NEC), Latest Edition

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in General Conditions and Section entitled "Submittals," the Contractor shall obtain from the equipment manufacturer and submit the following:
 - 1. Shop Drawings
 - 2. Operation and Maintenance Manuals

1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for re-submittal.
- C. Drawings submitted by the manufacturer shall be complete and documented to provide the Owner with operations and maintenance capabilities.
- D. Shop drawings for each SPD shall include but not be limited to:
 - 1. A Compliance, Deviations, and Exceptions (CD&E) letter. If the shop drawings are submitted without this CD&E letter, the submittal will be rejected. The letter shall include all comments, deviations and exceptions taken to the Drawings and Specifications by the Contractor AND Equipment Manufacturer/Supplier. This letter shall include a copy of this specification section. In the left margin beside each and every paragraph/item, a letter "C", "D", or "E" shall be typed or written in. The letter "C" shall be for full compliance with the requirement. The letter "D" shall be for a deviation from the requirement. The letter "E" shall be for taking exception to a requirement. Any requirements with the letter "D" or "E" beside them shall be provided with a full typewritten explanation of the deviation/exception. Handwritten explanation of the deviations/exceptions is not acceptable. The CD&E letter shall also address deviations, and exceptions taken to each Drawing related to this Specification Section.
 - 2. Product Data Sheets.
 - 3. Detailed drawings showing weights and dimensions.
 - 4. Wiring diagrams showing field connections.
 - 5. Proof that all products provided under this Section are UL listed and labeled by Underwriters Laboratories to UL1449, latest Edition. This proof shall be a copy of the data listed under the UL File Number for the manufacturer, which may be obtained from the UL Online Certification Directory. No other means of proving

compliance (such as manufacturer data sheets, marketing material, etc) will be considered acceptable.

6. Proof of Short Circuit Current Ratings (SCCR), Voltage Protection Ratings (VPRs) for all modes, Maximum Continuous Operating Voltage rating (MCOV), Nominal Discharge Current (In), and device listing Type shall be submitted using the same means as described in the paragraph above.
7. Proof that all products provided under this Section are UL listed and labeled by Underwriters Laboratories to UL 1283, latest Edition. This proof shall be a copy of the data listed under the UL File Number for the manufacturer, which may be obtained from the UL Online Certification Directory. No other means of proving compliance (such as manufacturer data sheets, marketing material, etc) will be considered acceptable.
8. Warranty Information

- E. The shop drawing information shall be complete and organized in such a way that the Engineer can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "Soft Cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Contractor intends to provide are to provide are acceptable and shall be submitted.

1.05 OPERATION AND MAINTENANCE MANUALS

- A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 1.

1.06 IDENTIFICATION

- A. Each SPD shall be identified by the circuit number and equipment name as indicated on the Drawings. A nameplate shall be securely affixed in a conspicuous place on each SPD. Nameplates shall be as specified in Section entitled "Electrical - Identification."

1.07 WARRANTY

- A. All SPDs, associated hardware, and supporting components shall be warranted to be free from defects in materials and workmanship, under normal use and in accordance with the instructions provided, for a period of twenty-five (25) years after acceptance of the equipment by the Owner.
- B. Any component or subassembly contained within the surge protection system that shows evidence of failure or incorrect operation during the twenty-five (25) year warranty period, shall be replaced by the manufacturer at no additional cost to the Owner.

PART 2 - PRODUCTS

2.01 GENERAL

- A. The SPD units shall be UL 1449 Listed and must bear the UL mark. Units that are “manufactured in accordance with” UL 1449 or tested by other testing agencies “in accordance with” UL 1449 are not acceptable and will be rejected.
- B. Type II SPD units shall be UL 1283 Listed and must bear the UL mark. Units that are “manufactured in accordance with” UL 1283 or tested by other testing agencies “in accordance with” UL 1283 are not acceptable and will be rejected. Further, SPD units using UL 1283 capacitors but not tested to UL 1283 will be rejected.
- C. SPDs shall be provided as a stand-alone unit, separate from the equipment to which they are connected.
- D. All stand-alone SPDs furnished and installed under this Contract shall be from the same manufacturer.
- E. SPD units installed downstream of variable frequency drives or solid state reduced voltage starters shall be suitable for that application.
- F. Each SPD unit shall be furnished with an integral disconnecting means, where not installed immediately downstream of an overcurrent protection device.

2.02 PRODUCTS

- A. Unless otherwise indicated, Type I surge protective devices (SPD) shall be furnished and when shown without upstream overcurrent protection on the Drawings. Type II SPDs shall be provided in all other locations. Type II SPDs shall not require the use of a specific upstream overcurrent device. SPDs shall be provided in the location, quantity, and Type (I or II) shown on the Drawings.
- B. Each SPD shall be rated for the voltage and configuration of the equipment to which it is connected.
- C. Each Type II SPD shall have UL 1283 EMI/RFI filtering with minimum attenuation of - 50dB at 100kHz.
- D. The short circuit current rating of each SPD shall match or exceed the rating of the equipment to which it is connected. The Contractor shall reference the Contract Documents for short circuit current rating of each piece of equipment.
- E. Each SPD system shall provide surge protection in all possible modes. Surge protection shall be as follows:

SYSTEM CONFIGURATION	MODES OF PROTECTION	NUMBER OF MODES
3-Phase Wye	L-N, L-G, N-G	10
3-Phase Delta	L-L, L-G	6
3-Phase Impedance Grounded	L-L, L-G	6

Single-Phase	L-N, L-G, N-G	3
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- F. Each SPD shall have a Maximum Continuous Operating Voltage (MCOV) of at least 115% of the nominal voltage of the equipment to which it is connected.
- G. The Nominal Discharge Current (I_n) of each SPD shall be 20kA. Peak surge current ratings shall not be used as a basis for applying the SPD to the system.
- H. The Voltage Protection Rating (VPR) of each SPD shall not exceed the following:

SYSTEM VOLTAGE	L-N	L-G	L-L	N-G
208Y/120	800V	800V	1200V	800V
480Y/277	1200V	1200V	2000V	1200V
480 DELTA	N/A	1800V	2000V	N/A
240 DELTA	N/A	1200V	1200V	N/A
120/240	800V	800V	1200V	800V

- I. The surge current rating for each SPD shall be as indicated on the Drawings. Surge current rating indicated is on a per phase basis.
- J. Each SPD shall be provided in an enclosure with NEMA rating based on area designations listed in section entitled "Boxes."
- K. Each SPD shall be provided with the following accessories:
1. Each individual module shall feature an LED indicating the individual module has all surge protection devices active. If any single component is taken off-line, the LED shall turn off and another LED shall illuminate, providing individual module as well as total system status indication.
 2. Surge counter.
 3. One set of Form C (SPDT) dry contacts rated for at least 5A at 120VAC.
- L. SPDs shall be as manufactured by Surge Suppression Inc., or Equal.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. The SPD units shall be furnished and installed as shown on the Drawings and in accordance with the manufacturer's installation instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.
- B. The SPD units shall be mounted such that the conductor lengths are as short as possible, but no greater than 36 inches. Any installation resulting in a conductor length of greater than 36 inches shall be reviewed with the Engineer as a special type of cable may need to be installed.

- C. The Contractor shall use a close nipple to enclose the conductors between the SPD and the equipment served. However, if due to field conditions a 90 degree conduit bend is required to connect the SPD to the equipment that it serves, the bend shall have a minimum radius of 36 inches to eliminate any potential for sharp bends in the conductors.
- D. Conductors between the equipment served and the SPD shall be 600V power wire and cable as specified in Section entitled "Low Voltage Wire and Cable." The individual conductors shall be gently twisted, and shall be sized as indicated on the Drawings.
- E. Prior to energizing, the Contractor shall verify that the SPD unit voltage and configuration is suitable for the system to which it is connected.
- F. Prior to energizing, the Contractor shall also verify that any Neutral to Ground bonding jumpers are installed as required.
- G. Prior to energizing, the Contractor shall also verify that the impedance of the equipment grounding conductor between the SPD and the grounding electrode system is less than 1 ohm.

3.02 TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:
 - 1. Shop Tests
 - a. Standard factory tests shall be performed on the equipment under this section. All tests shall be in accordance with the latest version of NEMA, ANSI, and UL standards.
 - b. All surge protective devices, subassemblies, and components shall be 100% tested and certified by the manufacturer to meet their published performance parameters.
 - 2. Field Tests
 - a. None required.

- END OF SECTION -

SECTION 16440 - DISCONNECT SWITCHES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install separately mounted, individual disconnect switches as specified herein and indicated on the Drawings.
- B. Disconnect switches for process instruments are not included in the scope of this Section and shall be as specified in Section entitled "Wiring Devices."

1.02 CODES AND STANDARDS

- A. Disconnect switches shall be designed, manufactured, and/or listed to the following standards as applicable:
 - 1. UL 98 – Enclosed and Dead-Front Switches
 - 2. UL 1203 – Standard for Explosion-proof and Dust-ignition-proof Electrical Equipment for use in Hazardous (Classified) Locations.
 - 3. NEMA 250 – Enclosures for Electrical Equipment
 - 4. NEMA KS 1 – Heavy Duty Enclosed and Dead-Front Switches

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section entitled "Submittals," the Contractor shall obtain from the equipment manufacturer and submit the following:
 - 1. Shop Drawings
 - 2. Spare Parts List
- B. Each submittal shall be identified by the applicable specification section.

1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete or illegible submittals will be returned to the Contractor without review for resubmittal.

- C. Shop drawings shall include but not be limited to:
 - 1. Product data sheets.
 - 2. Complete layout and installation drawings with clearly marked dimensions for each type/size/rating of disconnect switch.
 - 3. Assembled weight of each unit.
- D. The shop drawing information shall be complete and organized in such a way that the Engineer can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items that the Contractor intends to provide are acceptable and shall be submitted.

1.05 SPARE PARTS

- A. The equipment shall be furnished with all spare parts as recommended by the equipment manufacturer.
- B. One (1) complete set of spare fuses for each ampere rating installed shall be furnished and delivered to the Owner at the time of final inspection.
- C. Spare parts lists, included with the shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.
- D. Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same parts number.

1.05 IDENTIFICATION

- A. Each equipment item shall be identified with a nameplate. The nameplate shall be engraved indicating the circuit number and equipment name with which it is associated. Equipment identification shall be in accordance with Section entitled "Electrical - Identification."

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

- A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.
- B. Switches shall be manufactured by the Square D Company, Eaton, the General Electric Company, or Siemens Energy and Automation, Inc.

2.02 DISCONNECT SWITCHES

- A. Disconnect switches shall be heavy-duty type and/or as specified in these Specifications. Switches shall be furnished and installed as shown on the Drawings and as required by the NEC. Handles shall be lockable.
- B. Disconnect switches for non-hazardous areas shall be UL 98 Listed. Disconnect switches for hazardous areas shall be UL 1203 Listed.
- C. Switches shall meet NEMA Standard KS 1 type HD requirements, be, single-throw, be externally operated, and be fused or non-fused as indicated on the Drawings. Switches shall have the number of the poles, voltage, and ampere ratings as shown on the Drawings.
- D. In non-hazardous locations, disconnect switches shall be furnished with the following enclosure type and material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

AREA DESIGNATION	ENCLOSURE TYPE AND MATERIAL
All Outdoor Areas	NEMA 4X, Type 304 Stainless Steel

- E. Disconnect switches shall be quick-make, quick-break and with an interlocked cover which cannot be opened when switch is in the "ON" position and capable of being locked in the "OPEN" position.
- F. A complete set of fuses for all switches shall be furnished and installed as required. Time-current characteristic curves of fuses serving motors or connected in series with circuit breakers shall be coordinated for proper operation. Fuses shall have voltage rating not less than the circuit voltage.
- G. Disconnect switches shall be furnished with a factory installed internal barrier kit that helps prevent accidental contact with live parts and provides "finger-safe" protection when the door of the enclosed switch is open.
- H. Disconnect switches shall be furnished with a manufacturer-supplied ground lug kit for termination of equipment grounding conductors. Where a grounded (neutral) conductor is shown on the Drawings in the conduits connected to the disconnect switch, a manufacturer-supplied neutral bar shall be furnished for termination of the grounded conductors. Third party ground lug and neutral lug kits not supplied by the disconnect switch manufacturer are not acceptable.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. All disconnect switches shall be mounted five (5) feet above the floor or finished grade, at the equipment height where appropriate, or where shown otherwise.

- B. Disconnect switches shall be provided in the enclosure type and material of construction required for the area in which it is installed. Reference the requirements in Part 2 herein, and the area designations indicated on the Drawings.

3.02 TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:

- 1. Field Tests

- a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 1, and NETA Acceptance Testing Specifications, latest edition.

- END OF SECTION -

SECTION 16461 - DRY TYPE DISTRIBUTION TRANSFORMERS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, install, and test transformers for power and lighting distribution systems as specified herein, as indicated on the Drawings, and as required to complete the electrical installations.
- B. All equipment specified in this Section shall be furnished by the transformer manufacturer who shall be responsible for the suitability and compatibility of all included equipment.
- C. Reference Section entitled "Basic Electrical Requirements."

1.02 CODES AND STANDARDS

- A. Transformers shall conform to all applicable Federal, UL, and NEMA standards. Materials and components shall be new and conform to grades, qualities and standards as specified herein and shown on the Drawings.
- B. Transformers shall comply with the following standards:
 - 1. UL 1561 – Dry Type General Purpose and Power Transformers
 - 2. U.S. Department of Energy 2016 Efficiency
 - 3. National Electrical Code
 - 4. NEMA ST-20 – Dry Type Transformers for General Applications
 - 5. ANSI C57 – Standard General Requirements for Dry Type Distribution and Power Transformers

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Division 1, the Contractor shall obtain from the equipment manufacturer and submit the following:
 - 1. Shop Drawings.
 - 2. Operation and Maintenance Manuals.
 - 3. Spare Parts List.
 - 4. Reports of Certified Shop Field Tests.

- B. Each submittal shall be identified by the applicable specification section.

1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein, and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
 - 1. Product data sheets.
 - 2. Drawings showing clearly marked dimensions and weight for each transformer.
 - 3. Sample equipment nameplate diagram.
- D. The submittal information shall reflect the specific equipment identification number as indicated on the Drawings.
- E. The shop drawing information shall be complete and organized in such a way that the Engineer can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items that the Contractor intends to provide are acceptable and shall be submitted.

1.05 OPERATION AND MAINTENANCE MANUALS

- A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 1.

1.06 SPARE PARTS

- A. All spare parts as recommended by the equipment manufacturer shall be furnished to the Owner by the Contractor.
- B. Spare parts lists, included with the Shop Drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.
- C. Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same parts number.

1.07 IDENTIFICATION

- A. Each transformer shall be identified with the equipment item number indicated on the Contract Drawings and the accepted Shop Drawings. A nameplate shall be securely affixed

in a conspicuous place on each transformer. Nameplates shall be as specified in Section entitled "Electrical - Identification."

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

- A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.
- B. Dry type distribution transformers shall be Energy Star compliant and manufactured by the Square D Company, the General Electric Company, Eaton, or Siemens Energy and Automation, Inc.
- C. Dry type transformers shall meet DOE 2016 Energy Efficiency requirements.

2.02 DRY TYPE TRANSFORMERS

- A. Furnish and install single-phase and three-phase general purpose, dry-type transformers, as specified herein and indicated on the Drawings. The transformers shall be 60 Hz, self-cooled, quiet-design insulated of the two-winding type.
- B. The transformers shall be UL 1561 Listed.
- C. The primary windings shall be rated 480 VAC for use on 3-phase systems and connected delta unless indicated otherwise on the Drawings. KVA ratings shall be as shown on the Drawings. Furnish transformers with two 2-1/2% primary taps above, and four 2-1/2% primary taps below rated voltage for transformers 15 KVA and above, and two 2-1/2% primary taps above, and two 2-1/2% primary taps below rated voltage for transformers less than 15 kVA. All taps shall be full capacity rated.
- D. The voltage ratings of the secondary windings shall be as indicated on the Drawings.
- E. Transformers shall be designed for continuous operation at rated KVA, 24 hours a day, 365 days a year, with normal life expectancy as defined in IEEE 65 and ANSI C57.96. This performance shall be obtainable without exceeding 150 degrees Celsius average temperature rise by resistance or 180 degrees Celsius hot spot temperature rise in a 40-degrees Celsius maximum ambient and 30 degrees Celsius average ambient. The maximum coil hot spot temperature shall not exceed 220 degrees Celsius. All insulating materials shall be flame retardant and shall not support combustion as defined in ASTM Standard Test Method D 635. All insulating materials shall be in accordance with NEMA ST 20 Standard for a 220 degrees Celsius UL component recognized insulation system.
- F. Transformer coils shall be of the continuous wound copper construction and shall be impregnated with nonhygroscopic, thermosetting varnish.
- G. All cores are to be constructed of high grade, nonaging, grain-oriented silicon steel with high magnetic permeability and low hysteresis and eddy current losses. Magnetic flux densities

are to be kept well below the saturation point. The core laminations shall be tightly clamped and compressed with structural steel angles. The completed core and coil shall then be bolted to the base by means of vibration-absorbing mounts to minimize sound transmission. There shall be no metal-to-metal contact between the core and coil assembly and the enclosure.

- H. All transformers shall be equipped with a wiring compartment suitable for conduit entry and large enough to allow convenient wiring. The maximum temperature of the enclosure shall not exceed 90 degrees Celsius. Transformers shall be furnished with lugs of the size and quantity required and suitable for termination of the field wiring.
- I. The core of the transformer shall be visibly grounded to the enclosure by means of a flexible grounding conductor sized in accordance with applicable NEMA, IEEE, and ANSI standards.
- J. Transformers shall have core and coil assemblies mounted on rubber isolation pads to minimize the sound levels. Transformers shall not exceed the sound levels listed in NEMA ST-20.
- K. Transformers shall be furnished with the following enclosure type and material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

AREA DESIGNATION	ENCLOSURE TYPE AND MATERIAL
Indoor Wet Process Area	NEMA 3R, Painted Steel
Indoor Dry Process Area	NEMA 2, Painted Steel
Indoor Dry Non-process Area	NEMA 2, Painted Steel
All Outdoor Areas	NEMA 3R, Painted Steel

- L. The enclosure shall be made of heavy gauge steel and shall be degreased, cleaned, primed, and finished with a baked weather-resistant enamel using the manufacturer's standard painting process. Color shall be ANSI 61.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. The transformers shall be furnished and installed as shown on the Drawings and as recommended by the equipment manufacturer.
- B. Conduit routed to and from the transformer shall be arranged for easy removal of the transformer access covers.
- C. Where transformers 50 kVA and smaller are shown to be wall mounted, a transformer manufacturer supplied wall mounting kit shall be used. The lowest point of the wall mounting bracket shall be no lower than 7'-0" above the finished floor. Field fabricated mounting hardware is not acceptable unless reviewed and approved in writing by the Engineer.

- D. Prior to final completion of the work, all metal surfaces of the equipment shall be cleaned thoroughly, and all scratches and abrasions shall be retouched with the same lacquer as used for shop finishing coats.

3.02 TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:

- 1. Certified Shop Tests

- a. The transformers shall be given routine factory tests in accordance with the requirements of the ANSI and NEMA standards. Temperature rises may be certified from basic design.
- b. As a minimum, the following tests shall be made on all transformers:
 - i. Ratio tests on the rated voltage connection and on all tap connections.
 - ii. Polarity and phase-relation tests on the rated voltage connection.
 - iii. Applied potential tests.
 - iv. Induced potential tests.
 - v. No-load and excitation current at rated voltage on the rated voltage connection.

- 2. Field Tests

- a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 1, and NETA Acceptance Testing Specifications, latest edition.
- b. Insulation between windings shall be tested by 1000 VDC Megaohmmeter for one (1) minute. Resistance value shall be no less than 100 Megaohms.

- END OF SECTION -

SECTION 16500 - LIGHTING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install all lighting fixtures, labor, and material, in accordance with the preceding Specifications, the requirements of this Section, and as shown on the Drawings.
- B. Lighting shall be in accordance with the latest requirements of the Illuminating Engineering Society, and all lighting fixtures shall have the Underwriters Laboratories, Inc. label of approval.
- C. All wiring shall be placed in conduit and shall comply with the Specifications for conduit, outlet boxes, pull and junction boxes, wires and cables, grounding, and other Sections as set forth in these Specifications and as noted herein.
- D. Reference Section entitled "Basic Electrical Requirements," and Section entitled "Grounding and Bonding."

1.02 CODES AND STANDARDS

- A. The equipment specified herein shall comply with the following codes and standards, where applicable.
 - 1. Underwriter's Laboratories, Inc. (UL):
 - a. UL 924 – Emergency Lighting and Power Equipment
 - b. UL 935 – Fluorescent Lamp Ballasts
 - c. UL 844 – Luminaires for Use in Hazardous (Classified) Locations
 - d. UL 1029 – High Intensity Discharge Lamp Ballasts
 - e. UL 1598 – Luminaires
 - 2. American National Standards Institute (ANSI):
 - a. ANSI C82.11 – High Frequency Fluorescent Lamp Ballasts
 - b. ANSI C62.41 – Guide for Surge Voltages in Low-Voltage AC Power Circuits
 - 3. National Electrical Code (NEC), latest edition.

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section entitled "Submittals," the Contractor shall obtain from the equipment manufacturer and submit the following:
 - 1. Shop Drawings
 - 2. Operation and Maintenance Manuals
 - 3. Spare Parts Lists
- B. Each submittal shall be identified by the applicable specification section.

1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete or illegible submittals will be returned to the Contractor for resubmittal without review.
- C. Shop drawings shall include but not be limited to:
 - 1. Product data sheets.
 - 2. Catalog cuts for each fixture type showing performance and construction details of standard fixtures, and complete working drawings showing all proposed construction details of special or modified standard fixtures.
 - 3. Photometric curves.
 - 4. LED data including efficiency (Efficacy lumens/watt) information.
 - 5. LED Driver information
 - 6. Catalog data including applicable coefficients of utilization tables, isolux chart of illumination on a horizontal plane, beam efficiency, horizontal and vertical beam spread, and beam lumens.
 - 7. Manufacturer's warranty information
 - 8. Pole calculations.
- D. Shop drawings shall be submitted to the Engineer for review and acceptance for all fixtures before fixtures and poles are manufactured. Substitutions will be permitted only if acceptable to the Engineer.

- E. Manufacturer's catalog number and description in the fixture schedule on the Contract Documents establishes a level of quality, style, finish, etc. The use of a catalog number describing the various types of fixtures shall be used as a guide only, and does not exclude all the required accessories or hardware that may be required for a complete installation.

1.05 OPERATION AND MAINTENANCE MANUALS

- A. The Contractor shall submit Operation and Maintenance Manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 1.

1.06 SPARE PARTS

- A. All spare parts as recommended by the equipment manufacturer shall be furnished to the Owner by the Contractor. The following minimum spare parts shall be furnished:
 - 1. One (1) LED driver.
- B. The spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.
- C. Spare parts shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such spare parts until completion of the work, at which time they shall be delivered to the Owner.
- D. Spare parts lists, included with the shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.
- E. Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same parts number.

1.07 LIGHTING CONTROLS

- A. The lighting systems shall be controlled as specified herein and indicated on the Drawings.

1.08 WARRANTY

- A. The manufacturer's warranty shall in no event be for a period of less than five (5) years from date of delivery of fixtures to the project site and shall include repair labor, travel expense necessary for repairs at the jobsite, shipping costs, expendables used during the course of repair, or complete replacement of the failed lighting unit.
- B. Warranty for LED fixtures shall be provided for the entire fixture and shall include all parts and accessories. Submittals received without written warranties as specified shall be rejected in their entirety.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

- A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

2.02 FIXTURES

- A. Each fixture shall bear the Underwriters Laboratories, Inc. label. All lighting fixtures shall be furnished complete with LED's and drivers, as indicated on the Drawings, and all fittings and hardware necessary for a complete installation. Lighting fixtures shall have all parts and fittings necessary to completely and properly install the fixtures.
- B. Fixture leads shall be as required by NEC and shall be grounded by the equipment grounding conductor in the conduit.
- C. All glassware shall be high quality, homogeneous in texture, uniform in quality, free from defects, of uniform thickness throughout, and properly annealed. Edges shall be well rounded and free from chips or rough edges.
- D. Fixtures specified to be damp or wet locations rated shall be UL 1598 listed.
- E. Fixtures shall be furnished as shown on the drawings.

2.03 LED DRIVERS

- A. Drivers shall have a voltage range of (120-277) +/- 10% at a frequency 60Hz.
- B. All drivers shall be designed to a power factor >90% with a total harmonic distortion THD <20% at full load.
- C. Case temperature shall be rated for -40°C through +80°C.
- D. Drivers shall have overheat protection, self-limited short circuit protection and overload protected.
- E. Drivers shall be furnished with a fused primary.
- F. Drivers shall have an output current ripple <30%
- G. Drivers shall be manufactured by Advance, Universal or equal.
- H. Drivers shall be UL Listed for damp location, UL1012, UL935, ROHS.
- I. Drivers shall meet FCC 47 Sub Part 15.

- J. All drivers shall be provided with ANSI/IEEE C62.41 Category C (10kV/5kA) surge protection.

2.04 LEDs

- A. Luminaires provided with LED technology shall utilize high brightness LEDs with a group binning code of P and/or Q.
- B. Color Temperature: as specified in fixture schedule.
- C. Junction point shall be designed and manufactured to allow adequate heat dissipation.
- D. LEDs shall be rated for 50,000 hours of life, minimum (based on IESNA L70).

2.05 POLES

- A. Poles shall be designed, with proposed fixture attached, to withstand calculated wind force based on 125 MPH (3-second gust) wind velocity in accordance with the provisions of the Florida Building Code without structural damage.
- A. Pole mounted fixtures shall be mounted on poles as designated in the fixture schedule or as indicated on the Drawings. Poles shall have adequate handholes and weatherproof receptacles where indicated. All anchor bolts and nuts shall be stainless steel.
- C. Photocells shown on the Drawings that are not integral to a fixture provided by the (lighting manufacturer) shall be provided by the Contractor. Photocells shall be rated for 120 VAC, 1800W, and be provided with 1/2" or 3/4" threads for box mounting. Photocells shall be Model K4121C by Intermatic, or equal.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. The Contractor shall provide and install all inserts, conduit, structural supports as required, lamps, ballasts, poles, wiring, and any other items required for a complete system. Contractor shall properly adjust and test, to the satisfaction of the Engineer, the entire lighting system. The Contractor shall provide pigtails and flexible conduit connected to an outlet box where necessary or required resulting in a neat and complete installation.
- B. The Contractor shall protect all fixtures at all times from damage, dirt, dust, and the like.
- C. The Contractor shall install fixtures at mounting heights indicated on the Drawings or as instructed by the Engineer.
- D. Upon completion of work, and after the area is broom clean, all fixtures shall be made clean and free of dust and all other foreign matter both on visible surfaces, and on surfaces that affect the lighting performance of the fixture including diffusers, lenses, louvers, reflectors, and lamps.

- E. All fixtures that require physical adjustment shall be so adjusted in accordance with the directions of the Engineer. The Contractor shall also adjust angular direction of fixtures and/or lamps, as directed.
- F. Relamping access of fixtures including LED fixtures shall require no special tools. All optical control surfaces such as lenses and reflectors shall be safely and securely attached to fixtures and shall be easily and quickly removed and replaced for cleaning without the use of special tools. No fixture part that may be removed, for maintenance, shall be held in place by metal tabs that must be bent to remove said part.
- H. The Contractor shall furnish and install photocells as specified herein or indicated on the Drawings. The Contractor shall furnish and install photocells as specified herein or indicated on the Drawings for automatic "ON/OFF" switching of outdoor lighting.
- I. The Contractor shall furnish and install a concrete foundation for the pole mounted fixtures as indicated on the Drawings and as required. This applies to foundations for pole mounted fixtures located in the yard (i.e. site lighting) and foundations that are part of a structure.

3.02 TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:
 - 1. Certified Shop Tests
 - a. The lighting fixtures shall be given routine factory tests in accordance with the requirement of ANSI, NEMA and Underwriters Laboratories standards.
 - 2. Field Tests
 - a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 1, and NETA Acceptance Testing Specifications, latest edition.

- END OF SECTION -

SECTION 16902 - ELECTRIC CONTROLS AND RELAYS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, install, test, and place in satisfactory operation all electric controls and relays as specified herein and indicated on the Drawings.
- B. Electrical control and relay systems shall be assembled using NEMA rated components. Components designed and built to International Electrotechnical Commission (IEC) standards are not recognized. Equipment designed, manufactured and labeled in compliance with IEC standards is not acceptable.
- C. Reference Sections entitled "Basic Electrical Requirements" and "Electrical Identification."

1.02 CODES AND STANDARDS

- A. Products specified herein shall be in conformance with or listed to the following standards as applicable:
 - 1. NEMA 250 – Enclosures for Electrical Equipment
 - 2. UL 508A – Standard for Industrial Control Panels

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section entitled "Submittals," the Contractor shall obtain from the equipment manufacturer and submit the following:
 - 1. Shop Drawings
 - 2. Spare Parts List
- B. Each submittal shall be identified by the applicable specification section.

1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:

1. Product data sheets.

- D. The shop drawing information shall be complete and organized in such a way that the Engineer can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Contractor intends to provide are acceptable and shall be submitted.

1.05 SPARE PARTS

- A. All spare parts as recommended by the equipment manufacturer shall be furnished to the Owner by the Contractor. In addition to the manufacturer recommended spare parts, the following spare parts shall be provided for the local control stations:
1. One (1) contact block of each type furnished on the project
 2. One (1) indicating light lens of each color furnished on the project
 3. One (1) LED lamp of each color furnished on the project
- B. The spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.
- C. Spare parts shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such spare parts until completion of the work, at which time they shall be delivered to the Owner.
- D. Spare parts lists, included with the shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.
- E. Parts shall be completely identified with a numerical system to facilitate parts control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same part number.

PART 2 -- PRODUCTS

2.01 CONTROL COMPONENTS

- A. Manufacturers
1. Control components shall be manufactured by Eaton, The Square D Company, General Electric, Allen-Bradley, Siemens Energy and Automation, or Engineer approved equal.
- B. Pilot Devices
1. General

- a. All pilot devices shall be provided with a legend plate. Legend plates shall have a white background and black lettering and indicate the function of the respective pilot device. The text shown on the Drawings or indicated in the specifications shall be used as the basis for legend plate engraving.
- b. All pilot devices shall be selected and properly installed to maintain the NEMA 250 rating of the enclosure in which they are installed. All pilot devices shall be UL 508 Listed.
- c. All pilot devices shall be 30.5mm in diameter, unless otherwise indicated. 22mm devices are not acceptable.
- d. Pilot devices for all electrical equipment under this Contract shall be of the same type and manufacturer unless otherwise specified herein or indicated on the Drawings.

2. Pushbuttons

- a. Pushbuttons shall be non-illuminated, black in color, and have momentary style operation unless otherwise indicated on the Drawings.
- b. Pushbuttons shall have the quantity of normally closed and/or normally open contacts as indicated on the Drawings and as required. In addition to the required contacts, one (1) spare normally open and one (1) spare normally closed contact shall be installed at each pushbutton. Contacts shall be rated for 5A at 250VAC/DC (minimum), but no less than required for the application.
- c. Pushbuttons shall be provided with a full guard around the perimeter of the button. Where a lockout style pushbutton is specified or indicated on the Drawings, provide a padlockable guard.

3. Selector Switches

- a. Selector switches shall be non-illuminated, black in color, and have the number of maintained positions as indicated on the Drawings and as required. Handles shall be the extended type that provide a greater surface area for operation.
- b. Selector switches shall have the quantity of normally closed and/or normally open contacts as indicated on the Drawings and as required. In addition to the required contacts, one (1) spare normally open and one (1) spare normally closed contact shall be installed at each selector switch. Contacts shall be rated for 5A at 250VAC/DC (minimum), but no less than required for the application.
- c. Where indicated in the Drawings or Specifications, provide spring return positions.

- d. Selector switches shall be provided with an indexing component that fits into the keyed portion of the cutout for the device and prevents the switch from spinning when operated.
- 4. Indicating Lights
 - a. Indicating lights shall LED type, with the proper voltage rating to suit the application, and push-to-test feature.
 - b. Indicating light lens colors shall be as required in equipment specifications and/or as indicated on the Drawings. If lens colors are not indicated, the following colors shall be used:

Red	-	"Run", "On", "Open"
Green	-	"Off", "Closed"
Amber	-	"Alarm", "Fail"
White	-	"Control Power On"
- 5. Emergency Stop and Tagline Switches
 - a. Emergency stop switches shall be non-illuminated, red in color, with a minimum 35mm diameter mushroom head. Once activated, switch shall maintain its position and require a manual pull to release/reset.
 - b. Tagline switches shall have a plunger that activates upon tension from the associated safety cable. Once activated, switch shall maintain its position and require a manual release/reset.
 - c. Emergency stop and tagline switches shall have the quantity of normally closed and/or normally open contacts as indicated on the Drawings and as required. In addition to the required contacts, one (1) spare normally open and one (1) spare normally closed contact shall be installed at each switch. Contacts shall be rated for 5A at 250VAC/DC (minimum), but no less than required for the application.

Relays and Timers

- 1. General
 - a. Relays and timers shall be furnished with an integral pilot light for positive indication of coil energization.
 - b. Relays and timers shall have tubular pin style terminals with matching 11-pin DIN rail mount socket. Spade or blade style terminals are not acceptable.
 - c. Relays and timers for all electrical equipment under this Contract shall be of the same type and manufacturer unless otherwise specified herein or indicated on the Drawings.

2. Control and Pilot Relays

- a. Miniature or "ice-cube" type relays are not acceptable.
- b. Relays shall have coil voltage as required to suit the application and/or as indicated on the Drawings.
- c. Relays shall be provided with contacts rated for 10A (resistive), minimum, at 120/240 VAC and 28 VDC. Relays shall have 3-pole, double-throw (3PDT) contact arrangement.

3. Time Delay Relays

- a. Timers delay relays shall utilize electronic timing technology. Mechanical timing devices are not acceptable.
- b. Relays shall have coil voltage as required to suit the application and/or as indicated on the Drawings.
- c. Relays shall be provided with contacts rated for 10A (resistive), minimum, at 120/240 VAC and 28 VDC. Relays shall have double-pole double-throw (DPDT) contact arrangement.
- d. Time delay ranges shall be as indicated on the Drawings and/or as required to suit the application. Timing range shall be adjustable from the front of the relay. On delay and off delay timer configurations shall be provided as indicated on the Drawings and/or as required to suit the application.

4. Elapsed Time Meters

- a. Elapsed time meters shall be non-resettable type with no less than a 4 digit display. Coil voltage shall be as required to suit the application and/or as indicated on the Drawings.

C. Control Terminal Blocks

- 1. Control terminal blocks shall be assembled on non-current carrying galvanized steel DIN mounting rails securely bolted to the enclosure or subpanel. Terminals shall be tubular screw type with pressure plate that will accommodate wire size range of #22 - #8 AWG.
- 2. Control terminal blocks shall be single tier with a minimum rating of 600 volts and 20A. Separate terminal strips shall be provided for each type of control used (i.e. 120VAC vs. 24VDC). Quantity of terminals shall be provided as required to suit the application. In addition, there shall be a sufficient quantity of terminals for the termination of all spare conductors.
- 3. Terminals shall be marked with a permanent, continuous marking strip, with each terminal numbered. One side of each terminal shall be reserved exclusively for

incoming field conductors. Common connections and jumpers required for internal wiring shall not be made on the field side of the terminal.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. All control components shall be mounted in a manner that will permit servicing, adjustment, testing, and removal without disconnecting, moving, or removing any other component. Components mounted on the inside of panels shall be mounted on removable plates and not directly to the enclosure. Mounting shall be rigid and stable unless shock mounting is required otherwise by the manufacturer to protect equipment from vibration. Component's mounting shall be oriented in accordance with the component manufacturer's and industries' standard practices.
- B. Pilot devices shall be properly bonded to the equipment enclosure door where they are installed. If proper bonding cannot be achieved through the locknuts that affix the device in place, a green colored bonding screw shall be provided on the pilot device. The bonding screw shall be bonded to the equipment enclosure through the use of an insulated green bonding conductor.
- C. Terminal strips, relays, timers, and similar devices shall not be installed on the rear of the panel/cabinet doors. Terminal strips, relays, timers, and similar devices shall not be installed on the side walls of panel/cabinet interiors without written permission from the Engineer.

- END OF SECTION -

SECTION 17000 - CONTROL AND INFORMATION SYSTEM, GENERAL

PART 1 -- GENERAL

1.01 SCOPE

- A. The Contractor shall provide, through the services of the instrumentation and control system subcontractor, all components, system installation services, as well as all required and specified ancillary services in connection with the Instrumentation, Control and Information System. The System includes all materials, labor, tools, fees, charges and documentation required to furnish, install, test and place in operation a complete and operable instrumentation, control and information system as shown and/or specified. The system shall include all measuring elements, signal converters, transmitters, control panels, cabinets, digital hardware and software, operator interface terminals, signal and data transmission systems, interconnecting wiring, brackets, supports, piping, tubing, valves, mounting hardware, and such accessories as shown, specified, and/or required to provide the functions indicated.
- B. The Contractor shall take note that the Section entitled "Summary of Work" includes specific construction sequencing restrictions that impact the performance of the Work as specified in Division 17. The Contractor shall coordinate sequence requirements between its various Project subcontractors as necessary to meet all requirements as specified in the contract documents.
- C. The general scope of work to be performed under this Division includes, but is not limited to, the following:
 - 1. The Contractor shall retain overall responsibility for the instrumentation and control system as specified herein.
 - 2. Furnish and install process instrumentation and associated taps, nipples, valves, tubing, and supports as scheduled or shown on the Drawings, unless otherwise noted or supplied by equipment vendors.
 - 3. Furnish and install control equipment, field panels and associated cabinets and control panels as shown on the drawings and as specified in this Division.
 - 4. Furnish and install digital control system hardware and software as specified in this Division, including but not limited to:
 - a. One (1) complete Data Flow Systems (DFS) remote terminal unit (RTU) with Allen-Bradley MicroLogix 1400 and appurtenances.
 - b. Radio telemetry antenna, cable, tower and appurtenances.
 - c. Modification of the existing DFS Hyper SCADA Server and workstation to incorporate the new RTU.
 - 5. Final termination and testing of all instrumentation and control system signal wiring and power supply wiring at equipment furnished under this Division.
 - 6. Furnish and install transient voltage surge suppression systems for all digital equipment, data communications equipment, local control panels, and field instruments provided under this Division, including connections to grounding system(s) provided under Division 16.
 - 7. Coordinate grounding requirements with the electrical subcontractor for all digital equipment, local control panels, and field instrumentation provided under this

Division. Terminate grounding system cables at all equipment provided under this Division.

8. Provide system testing, calibration, training and startup services as specified herein and as required to make all systems fully operational.
9. Furnish and install embedded supports, instrument stands, brackets, mounting hardware, piping, tubing, isolation valves and related items required for instrumentation and equipment furnished under Division 17.
10. The Contractor shall coordinate all work specified herein with related work specified in other Divisions, and shall schedule the work to minimize downtime of equipment and controls as described in the Section entitled "Maintenance of Utility Operations During Construction". The Contractor shall provide temporary equipment and interconnecting cables as described herein and as shown on the Drawings.

- D. It is the intent of the Contract Documents to construct a complete and working installation. Items of equipment or materials that may reasonably be assumed as necessary to accomplish this end shall be supplied whether or not they are specifically stated herein.

1.02 RELATED ITEMS

- A. Field mounted switches, torque switches, limit switches, valve and gate operator position transmitters, sump pump controls and other instrumentation and controls furnished with mechanical or electrical equipment not listed in the instrument schedule shall be furnished, installed, tested and calibrated as specified under other Divisions.
- B. Additional and related work performed under Division 16 includes the following:
1. Conduit and raceways for all instrumentation and control system signal wiring, grounding systems, special cables and data highway cables.
 2. Instrumentation and control system signal wiring. See termination requirements below.
 4. Install (pull in conduit system) Ethernet data highway network and fiber optic data communications cables.
 5. Furnish and install grounding systems for all digital equipment, local control panels, and field instrumentation provided under Division 17. Grounding systems shall be complete to the equipment provided under Division 17, ready for termination by the instrumentation subcontractor.
 6. Termination of all instrumentation and control system grounding, signal and data communications cables, wiring and surge suppression devices at the equipment end of all equipment furnished under other Divisions of the Specifications. Wiring systems shall be installed complete to the equipment provided under Division 17, ready for termination by the instrumentation subcontractor.
 7. Final wiring and termination to A.C. grounding systems and to A.C. power sources (e.g. panelboards, motor control centers, and other sources of electrical power).

1.03 GENERAL INFORMATION AND DESCRIPTION

- A. Where manufacturers are named for a particular item of equipment, it is intended as a guide to acceptable quality and performance and does not exempt such equipment from the requirements of these Specifications or Drawings.

- B. In order to centralize responsibility, it is required that all equipment (including field instrumentation and control system hardware and software) offered under this Division shall be furnished and installed by the instrumentation subcontractor, or under the supervision of the instrumentation subcontractor, who shall assume complete responsibility for proper operation of the instrumentation and control system equipment, including that of coordinating all signals, and furnishing all appurtenant equipment.
- C. The Contractor shall retain total responsibility for the proper detailed design, fabrication, inspection, test, delivery, assembly, installation, activation, checkout, adjustment and operation of the entire instrumentation and control system as well as equipment and controls furnished under other Divisions of the Specifications. The Contractor shall be responsible for the delivery of all detailed drawings, manuals and other documentation required for the complete coordination, installation, activation and operation of mechanical equipment, equipment control panels, local control panels, field instrumentation, control systems and related equipment and/or systems and shall provide for the services of a qualified installation engineer to supervise all activities required to place the completed facility in stable operation under full digital control.
- D. The instrumentation and control system shall be capable of simultaneously implementing all real-time control and information system functions, and servicing all operator service requests as specified, without degrading the data handling and processing capability of any system component. It shall also be possible to simultaneously generate displays on all workstations and print out data on all printers without degradation of system performance.
- E. Control system inputs and outputs are listed in the Input/Output Schedule. This information, together with the control strategy descriptions, process and instrumentation diagrams, and electrical control schematics, describes the real-time monitoring and control functions to be performed. In addition, the system shall provide various man/machine interface and data reporting functions as specified in the software sections of this Specification.
- F. The mechanical, process, and electrical drawings indicate the approximate locations of field instruments, control panels, systems and equipment as well as field-mounted equipment provided by others. The instrumentation subcontractor shall examine the mechanical, process and electrical drawings to determine actual size and locations of process connections and wiring requirements for instrumentation and controls furnished under this Contract. The instrumentation subcontractor shall inspect all equipment, panels, instrumentation, controls and appurtenances either existing or furnished under other Divisions of the Specifications to determine all requirements to interface same with the control and information system. The Contractor shall coordinate the completion of any required modifications with the associated supplier of the item furnished.
- G. The instrumentation subcontractor shall review and approve the size and routing of all instrumentation and control cable and conduit systems furnished by the Electrical Contractor for suitability for use with the associated cable system.
- H. The Contractor shall coordinate the efforts of each supplier to aid in interfacing all systems. This effort shall include, but shall not be limited to, the distribution of approved shop drawings to the Electrical Contractor and to the instrumentation subcontractor furnishing the equipment under this Division.
- I. The Contractor shall be responsible for providing a signal transmission system free from electrical interference that would be detrimental to the proper functioning of the instrumentation and control system equipment.

- J. The Owner shall have the right of access to the subcontractor's facility and the facilities of its equipment suppliers to inspect materials and parts; witness inspections, tests and work in progress; and examine applicable design documents, records and certifications during any stage of design, fabrication and tests. The instrumentation subcontractor and its equipment suppliers shall furnish office space, supplies and services required for these surveillance activities.
- K. The terms "Instrumentation", "Instrumentation and Control System", and "Instrumentation, Control and Information System" shall hereinafter be defined as all equipment, labor, services and documents necessary to meet the intent of the Specifications.

1.04 INSTRUMENTATION AND CONTROL SYSTEM SUBCONTRACTORS

- A. Instrumentation and control system subcontractors shall be regularly engaged in the detailed design, fabrication, installation, and startup of instrumentation and control systems for municipal water treatment facilities. Instrumentation and control system subcontractors shall have a minimum of five years of such experience, and shall have completed a minimum of three projects of similar type and size as that specified herein. As used herein, the term "completed" shall mean that a project has been brought to final completion and final payment has been made. Any instrumentation and control system subcontractor that has been subject to litigation or the assessment of liquidated damages for nonperformance on any project within the last five calendar years shall not be acceptable.

1.05 DEFINITIONS

- A. Solid State: Wherever the term solid state is used to describe circuitry or components in the Specifications, it is intended that the circuitry or components shall be of the type that convey electrons by means of solid materials such as crystals or that work on magnetic principles such as ferrite cores. Vacuum tubes, gas tubes, slide wires, mechanical relays, stepping motors or other devices will not be considered as satisfying the requirements for solid state components of circuitry.
- B. Bit or Data Bit: Whenever the terms bit or data bit are used in the Specification, it is intended that one bit shall be equivalent to one binary digit of information. In specifying data transmission rate, the bit rate or data bit rate shall be the number of binary digits transmitted per second and shall not necessarily be equal to either the maximum pulse rate or average pulse rate.
- C. Integrated Circuit: Integrated circuit shall mean the physical realization of a number of circuit elements inseparably associated on or within a continuous body to perform the function of a circuit.
- D. Mean Time Between Failures (MTBF): The MTBF shall be calculated by taking the number of system operating hours logged during an arbitrary period of not less than six months and dividing by the number of failures experienced during this period plus one.
- E. Mean Time to Repair (MTTR): The MTTR shall be calculated by taking the total system down time for repair over an arbitrary period of not less than six months coinciding with that used for calculation of MTBF and dividing by the number of failures causing down time during the period.
- F. Availability: The availability of a non-redundant device or system shall be related to its MTBF and MTTR by the following formula:

$$A = 100 \times (\text{MTBF} / (\text{MTBF} + \text{MTTR})) \text{ Percent}$$

The availability of a device or system provided with an automatically switched backup device or system shall be determined by the following formula:

$$A = A2 + 1 - ((1-A1) \times (1-A1))$$

where:

A1 = availability of non-redundant device or system

A2 = availability of device or system provided with an automatically switched backup device or system

G. Abbreviations: Specification abbreviations include the following:

A	- Availability
ADC	- Analog to Digital Converter
AVAIL	- Available
ATA	- Advanced Technology Attachment
BCD	- Binary Coded Decimal
CSMA/CD	- Carrier Sense Multiple Access/Collision Detect
CPU	- Central Processing Unit
CRC	- Cyclic Redundancy Check
CRT	- Cathode Ray Tube
CS	- Control Strategy
DAC	- Digital to Analog Converter
DBMS	- Data Base Management System
DDR	- Double Data Rate
DIMM	- Dual In-line Memory Module
DMA	- Direct Memory Access
DPDT	- Double Pole, Double Throw
DVD	- Digital Video Disc
DVE	- Digital to Video Electronics
ECC	- Error Correction Coding
EPROM	- Erasable Programmable Read Only Memory
FDM	- Frequency Division Multiplexing
FSK	- Frequency Shift Keyed
GB	- Gigabyte
Gbps	- Gigabits per second
HMI	- Human Machine Interface
I/O	- Input/Output
LAN	- Local Area Network

LCD	- Liquid Crystal Display
LED	- Light Emitting Diode
MB	- Megabyte
Mbps	- Megabits per second
MCC	- Motor Control Center
MTBF	- Mean Time Between Failures
MTTR	- Mean Time To Repair
OS	- Operating System
OIT	- Operator Interface Terminal
PCB	- Printed Circuit Board
PLC	- Programmable Logic Controller
RAID	- Redundant Array of Inexpensive Discs
PROM	- Programmable Read Only Memory
RAM	- Random Access Memory
RMSS	- Root Mean Square Summation
ROM	- Read Only Memory
RTU	- Remote Telemetry Unit
SATA	- Serial ATA
SCADA	- Supervisory Control and Data Acquisition
SDRAM	- Synchronous Dynamic Random Access Memory
SIMM	- Single In-line Memory Module
SPDT	- Single Pole, Double Throw
TB	- Terabyte
TDM	- Time Division Multiplexing
TFT	- Thin Film Transistor
USB	- Universal Serial Bus
UPS	- Uninterruptible Power Supply
WAN	- Wide Area Network

- H. To minimize the number of characters in words used in textual descriptions on displays, printouts and nameplates, abbreviations may be used subject to Engineer approval. If a specified abbreviation does not exist for a particular word, an abbreviation may be generated using the principles of masking and or vowel deletion. Masking involves retaining the first and last letters in a word and deleting one or more characters (usually vowels) from the interior of the word.

1.06 ENVIRONMENTAL CONDITIONS

- A. Instrumentation equipment and enclosures shall be suitable for ambient conditions specified. All system elements shall operate properly in the presence of telephone lines, power lines, and electrical equipment.
- B. Inside control rooms and climate-controlled electrical rooms, the temperature will normally be 20 to 25 degrees Celsius; relative humidity 40 to 80 percent without condensation and the air will be essentially free of corrosive contaminants and moisture. Appropriate air filtering shall be provided to meet environmental conditions (i.e., for dust).
- C. Other indoor areas may not be air conditioned/heated; temperatures may range between 0 and 40 degrees Celsius with relative humidity between 40 and 95 percent.
- D. Outdoor equipment including instrumentation and panels may be subjected to wind, rain, lightning, and corrosives in the environment, with ambient temperatures from -20 to 40 degrees Celsius and relative humidity from 10 to 100 percent. All supports, brackets and interconnecting hardware shall be aluminum or Type 316 stainless steel as shown on the installation detail drawings.

PART 2 -- PRODUCTS

2.01 NAMEPLATES

- A. All items of equipment listed in the instrument schedule, control panels, and all items of digital hardware shall be identified with nameplates. Each nameplate shall be located so that it is readable from the normal observation position and is clearly associated with the device or devices it identifies. Nameplates shall be positioned so that removal of the device for maintenance and repair shall not disturb the nameplate. Nameplates shall include the equipment identification number and description. Abbreviations of the description shall be subject to Engineer approval.
- B. Nameplates shall be made of 1/16-inch thick machine engraved laminated phenolic plastic having white numbers and letters not less than 3/16-inch high on a black background.
- C. Nameplates shall be attached to metal equipment by stainless steel screws and to other surfaces by an epoxy-based adhesive that is resistant to oil and moisture. In cases where the label cannot be attached by the above methods, it shall be drilled and attached to the associated device by means of stainless steel wire.

PART 3 -- EXECUTION

3.01 SCHEDULE OF PAYMENT

- A. Payment to the Contractor for Control and Information System materials, equipment, and labor shall be in accordance with the General and Supplementary Conditions. The schedule of values submitted as required by the General and Supplementary Conditions shall reflect a breakdown of the work required for completion of the Control and Information System. The breakdown shall include sufficient detail to permit the Engineer to administer payment for the Control and Information System including, but not necessarily limited to, the following items:
 - 1. Mobilization
 - 2. Shop Drawing Submittals
 - 3. Process Instrumentation
 - 4. Control Panels

5. Programming
 6. Process Instrumentation Testing and Startup
 7. Control Panel Loop Testing
 8. Process Control Strategy Testing and Startup
 9. Training
 10. Final System Acceptance Testing
 11. Final Acceptance
- B. Requests for payment for materials and equipment that are not installed on site, but are required for shop fabrication and testing (e.g., digital hardware), or are properly stored as described in the Contract Documents and herein, shall be accompanied by invoices from the original supplier to the Contractor or instrumentation subcontractor substantiating the cost of the materials or equipment.
- C. No payment for programming shall be paid prior to approval of associated shop drawings. Upon approval of programming shop drawings, up to 50% of programming shall be payable. Upon completion of on-site loop checkout, up to 70% of programming shall be payable. Upon completion of functional tests, up to 90% of programming shall be payable. The remaining 10% shall be payable upon completion of the Final Acceptance Test.
- D. Any balance remaining within the schedule of values for field instruments and other materials installed on the site, or for other materials, for which payment is made by invoice, will be considered due upon completion of the Final Acceptance Test.
- 3.02 CLEANING
- A. The Contractor shall thoroughly clean all soiled surfaces of installed equipment and materials.
- B. Upon completion of the instrumentation and control work, the Contractor shall remove all surplus materials, rubbish, and debris that has accumulated during the construction work. The entire area shall be left neat, clean, and acceptable to the Owner.
- 3.03 FINAL ACCEPTANCE
- A. Final acceptance of the Instrumentation, Control and Information System will be determined complete by the Engineer, and shall be based upon the following:
1. Receipt of acceptable start up completion and availability reports and other documentation as required by the Contract Documents.
 2. Completion of the Availability Demonstration of the System as a whole.
 3. Completion of all punch-list items.
- B. Refer to the Section entitled "Project Closeout" for additional requirements.

- END OF SECTION -

SECTION 17030 - CONTROL AND INFORMATION SYSTEM SUBMITTALS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall submit complete Shop Drawings for all equipment in accordance with the Section entitled "Submittals". All submittal material shall be complete, legible, and reproducible, and shall apply specifically to this project.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Submittals
- B. Control and Information System

1.03 DIGITAL HARDWARE SUBMITTALS

- A. Submit system block diagram(s) showing:
 - 1. All equipment to be provided.
 - 2. All interconnecting cable.
 - 3. Equipment names, manufacturer, and model numbers.
 - 4. Equipment locations.
- B. Submit information for all digital equipment including, but not limited to, the following:
 - 1. Bill of materials with equipment names, manufacturers, complete model numbers and locations.
 - 2. Catalog cuts, including complete part number breakdown information.
 - 3. Complete technical, material and environmental specifications.
 - 4. Assembly drawings.
 - 5. Mounting requirements.
 - 6. Color samples.
 - 7. Nameplates.
 - 8. Environmental requirements during storage and operation.

1.04 SOFTWARE SUBMITTALS

- A. Software submittals shall include the following as a minimum:
 - 1. Bill of materials with software names, vendors, and complete listings of included software modules.
 - 2. Standard manufacturer's literature describing the products.
 - 3. Description of function of software in Control and Information System.
 - 4. Limitations or constraints of software.

5. Minimum system (processor and memory) requirements.
 6. Operation and maintenance requirements.
- B. Submit information on the following software:
1. Third-party software, including:
 - a. Operating system.
 - b. Programmable controller programming software (where applicable).
- C. Control Strategies
1. Provide control strategy documentation that includes control strategy diagrams (block oriented logic and ladder logic diagrams, as appropriate) to describe the control of all processes. The written description shall follow the format of the functional control descriptions contained herein. The control strategy submittals shall contain the following as a minimum:
 - a. An overall description of the program structure and how it will meet the specified control requirements.
 - b. A listing of the program.
 - c. Extensive comments in the listings to describe program steps.
 - d. Equation and ladder program derivations for all specified control routines.
 - e. Resource (processor and memory) requirements.
 - f. A listing of inputs and outputs to the control strategy.
- D. Application Software
1. Provide application software documentation that contains program descriptions for the operation, modification, and maintenance of all application programs provided for the digital system.
 2. Application software includes all custom routines developed specifically for this project, or pre-written routines used for accomplishing specified functions for this project. This shall include VBASIC and C programs, and any other add-in custom software.
- E. Graphic Displays
1. Submit all graphic displays required to perform the control and operator interface functions specified herein.
 2. Submit graphic displays for review by the Owner and the Engineer at least 60 days prior to commencement of factory testing.
 3. The Contractor shall allow for one major cycle of revisions to the displays prior to factory testing and one minor cycle of revisions following factory test. A cycle of revisions shall be defined as all revisions necessary to complete a single set of changes marked by the Engineer. Additional corrections shall be performed during

start-up as required to accommodate changes required by actual field conditions, at no additional cost to the Owner.

4. Two of the required submittals in each revision cycle shall be full color prints of the entire set of displays. Additional sets may be in black-and-white or gray-scale.
5. Displays shall be printouts of actual process graphics implemented in the system.

1.05 CONTROL PANEL SUBMITTALS

- A. Submittals shall be provided for all control panels, and shall include:
 1. Exterior panel drawings with front and side views, to scale.
 2. Interior layout drawings showing the locations and sizes of all equipment and wiring mounted within the cabinet, to scale.
 3. Panel area reserved for cable access and conduit entry.
 4. Location plans showing each panel in its assigned location.
- B. Submit information for all exterior and interior panel mounted equipment including, but not limited to, the following:
 1. Bill of materials with equipment names, manufacturers, complete model numbers and locations.
 2. Catalog cuts, including complete part number breakdown information.
 3. Complete technical, material and environmental specifications.
 4. Assembly drawings.
 5. Mounting requirements.
 6. Color samples.
 7. Nameplates.
 8. Environmental requirements during storage and operation.
- C. Submit panel wiring diagrams showing power, signal, and control wiring, including surge protection, relays, courtesy receptacles, lighting, wire size and color coding, etc.

1.06 INSTRUMENT SUBMITTALS

- A. Submit information on all field instruments, including but not limited to the following:
 1. Product (item) name and tag number used herein and on the Contract Drawings.
 2. Catalog cuts, including complete part number breakdown information.
 3. Manufacturer's complete model number.
 4. Location of the device.
 5. Input - output characteristics.
 6. Range, size, and graduations.

7. Physical size with dimensions, NEMA enclosure classification and mounting details.
8. Materials of construction of all enclosures, wetted parts and major components.
9. Instrument or control device sizing calculations where applicable.
10. Certified calibration data on all flow metering devices.
11. Environmental requirements during storage and operation.
12. Associated surge protection devices.

1.07 WIRING AND LOOP DIAGRAMS

- A. Submit interconnection wiring and loop diagrams for all panels and signals in the Control and Information System.
- B. Electrical interconnection diagrams shall show all terminations of equipment, including terminations to equipment and controls furnished under other Divisions, complete with equipment and cable designations. Where applicable, interconnection wiring diagrams shall be organized by input/output card. Interconnecting diagrams shall be prepared in a neat and legible manner on 11-inch by 17-inch reproducible prints.
- C. Loop drawings shall conform to the latest version of ISA Standards and Recommended Practices for Instrumentation and Control. Loop Drawings shall conform to ISA S5.4, Figures 1-3, Minimum Required Items.
- D. Loop drawings shall not be required as a separate document provided that the interconnecting wiring diagrams required in Paragraph B., above, contain all information required by ISA 5.4.

1.08 OPERATION AND MAINTENANCE MANUALS

- A. The Contractor shall deliver equipment operation and maintenance manuals in compliance with Section 01300 - Submittals. Operation and maintenance (O&M) manuals shall consist of two basic parts:
 1. Manufacturer standard O&M manuals for all equipment and software furnished under this Division.
 2. Custom O&M information describing the specific configuration of equipment and software, and the operation and maintenance requirements for this particular project.
- B. The manuals shall contain all illustrations, detailed drawings, wiring diagrams, and instructions necessary for installing, operating, and maintaining the equipment. The illustrated parts shall be numbered for identification. All modifications to manufacturer standard equipment and/or components shall be clearly identified and shown on the drawings and schematics. All information contained therein shall apply specifically to the equipment furnished and shall only include instructions that are applicable. All such illustrations shall be incorporated within the printing of the page to form a durable and permanent reference book.
- C. The manuals shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions, etc. that are required to instruct operation

and maintenance personnel unfamiliar with such equipment. The maintenance instructions shall include troubleshooting data and full preventive maintenance schedules. The instructions shall be bound in locking 3-D-ring binders with bindings no larger than 3.5 inches. The manuals shall include 15% spare space for the addition of future material. The instructions shall include drawings reduced or folded and shall provide the following as a minimum.

1. A comprehensive index.
 2. A functional description of the entire system, with references to drawings and instructions.
 3. A complete "as-built" set of all approved shop drawings, which shall reflect all work required to achieve final system acceptance.
 4. A complete list of the equipment supplied, including serial numbers, ranges, and pertinent data.
 5. Full specifications on each item.
 6. Detailed service, maintenance, and operation instructions for each item supplied.
 7. Special maintenance requirements particular to this system shall be clearly defined, along with special calibration and test procedures.
 8. Complete parts lists with stock numbers and name, address, and telephone number of the local supplier.
 9. References to manufacturers' standard literature where applicable.
 10. Warning notes shall be located throughout the manual where such notes are required to prevent accidents or inadvertent misuse of equipment.
- D. The operating instructions shall clearly describe the step-by-step procedures that must be followed to implement all phases of all operating modes. The instructions shall be in terms understandable and usable by operating personnel and maintenance crews and shall be useful in the training of such personnel.
- E. The maintenance instructions shall describe the detailed preventive and corrective procedures required, including environmental requirements during equipment storage and system operation, to keep the System in good operating condition. All hardware maintenance documentation shall make reference to appropriate diagnostics, where applicable, and all necessary wiring diagrams, component drawings and PCB schematic drawings shall be included.
- F. The hardware maintenance documentation shall include, as a minimum, the following information:
1. Operation Information - This information shall include a detailed description of how the equipment operates and a block diagram illustrating each major assembly in the equipment.
 2. Preventive-Maintenance Instructions - These instructions shall include all applicable visual examinations, hardware testing and diagnostic routines, and the adjustments necessary for periodic preventive maintenance of the System.

3. Corrective-Maintenance Instructions - These instructions shall include guides for locating malfunctions down to the card-replacement level. These guides shall include adequate details for quickly and efficiently locating the cause of an equipment malfunction and shall state the probable source(s) of trouble, the symptoms, probable cause, and instructions for remedying the malfunction.
 4. Parts Information - This information shall include the identification of each replaceable or field-repairable component. All parts shall be identified on a list in a drawing; the identification shall be of a level of detail sufficient for procuring any repairable or replaceable part. Cross-references between equipment numbers and manufacturer's part numbers shall be provided.
- G. Software documentation shall conform to a standard format and shall include, but not be limited to, the following:
1. A program abstract that includes:
 - a. Program Name - The symbolic alphanumeric program name.
 - b. Program Title - English text identification.
 - c. Program Synopsis - A brief text shall be provided that specifies the need for the program, states when it shall be used and functionally describes all inputs, outputs and functions performed. This descriptive text shall be written in a language that is understandable by nonsoftware oriented readers.
 2. A program description that shall include, but not be limited to, the following:
 - a. Applicable Documents - List all documents (standard manufacturer's literature, other program descriptions, etc.) by section, if practical, that apply to the program. One complete copy of all applicable reference material shall be provided.
 - b. Input - Output - Identify each input and output parameter, variable, and software element used by the program. State the purpose of all inputs, outputs, and variables.
 - c. Processing - This section shall contain a description of the overall structure and function of the program. Describe the program run stream and present a detailed description of how the program operates. Describe the timing and sequencing of operations of the program relative to other programs. Describe all interactions with other programs. Processing logic that is not readily described without considerable background information shall be handled as a special topic with references to an appendix or to control strategy document that details the necessary information. Reference shall also be made to an appendix or control strategy document for equation and program algorithm derivations.
 - d. System Configuration - Describe in detail the system configuration or status required for program implementation, if appropriate.
 - e. Limitations and Constraints - Summarize all known or anticipated limitations of the program, if appropriate.

- f. Storage - Define program storage requirements in terms of disk or RAM memory allocation.
- g. Verification - Describe, as a minimum, a test that can be used by the operator to assure proper program operation. Define the required system configuration, input requirements and criteria for successful test completion.
- h. Diagnostics - Describe all program diagnostics, where applicable. Descriptions shall list each error statement, indicate clearly what it means, and specify what appropriate actions should be taken.
- i. Malfunction Procedures - Specify procedures to follow for recovering from a malfunction due to either operator error or other sources.

1.09 FINAL SYSTEM DOCUMENTATION

- A. All documentation shall be delivered to the Owner prior to final system acceptance in accordance with the Contract Documents. As a minimum, final documentation shall contain all information originally part of the control system submittals.
- B. If any documentation or other technical information submitted is considered proprietary, such information shall be designated. Documentation or technical information which is designated as being proprietary will be used only for the construction, operation, or maintenance of the System and, to the extent permitted by law, will not be published or otherwise disclosed.
- C. Provide a complete set of detailed electrical interconnection diagrams required to define the complete instrumentation and control system. All diagrams shall be 11-inch by 17-inch original reproducible prints. All diagrams shall be corrected so as to describe final "as-built" hardware configurations and to reflect the system configuration and control methodology adopted to achieve final system acceptance.
- D. Provide system software documentation for the operation and maintenance of all system software programs provided as a part of the digital system. All system software documentation shall be amended as required to delineate all modifications and to accurately reflect the final as-built software configurations.
- E. Provide application software documentation that contains program descriptions for the operation, modification, and maintenance of all application programs provided for the digital system.
- F. Provide control strategy documentation which shall include control strategy (block oriented or ladder logic) diagrams to describe the control of all processes. Control strategy documentation shall reflect the system configuration and control methodology adopted to achieve final system acceptance. Control strategy documentation shall conform to the submittal requirements listed hereinabove.
- G. O&M documentation shall be amended with all final, adjusted values for all setpoints and other operating parameters for Owner reference.
- H. The Owner recognizes the fact that not all possible problems related to real-time events, software interlocks, and hardware maintenance and utilization can be discovered during the Acceptance Tests. Therefore, the instrumentation subcontractor through the Contractor shall investigate, diagnose, repair, update, and distribute all pertaining

documentation of the deficiencies that become evident during the warranty period. All such documentation shall be submitted in writing to the Owner within 30 days of identifying and solving the problem.

1.10 PROGRAMS AND SOURCE LISTINGS

- A. Provide one copy of all standard, off-the-shelf system and application software (exclusive of firmware resident software) on original media furnished by the software manufacturer.
- B. Provide one copy of source listings on DVD media for all custom software written specifically for this facility, all database files configured for this facility, and all control strategies. All source listings shall include a program abstract, program linkage and input/output data. Comments describing the program flow shall be frequently interspersed throughout each listing.

1.11 SUBMITTAL/DOCUMENTATION FORMAT

- A. All drawing-type submittals and documentation shall be rendered and submitted in the latest version of AutoCAD.
- B. All textual-type submittals and documentation shall be rendered and submitted in machine-readable Adobe Portable Document Format (.pdf).

1.12 ELECTRONIC O&M MANUALS

- A. Subject to acceptance by the Owner and Engineer, the O&M information may be submitted in part or in whole in an electronic format on optical media.
- B. Electronic O&M manuals shall contain information in machine-readable Adobe Portable Document Format (.pdf).

1.13 EXHIBITS

- A. See Exhibit 17030-01 (appended after the end of this Section) for sample LOOP STATUS REPORT and INSTRUMENT CALIBRATION SHEET forms.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

- END OF SECTION -

EXHIBIT 17030-01
CONTROL SYSTEM FORMS

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LOOP STATUS REPORT

Project Name:					Project No.		
FUNCTIONAL REQUIREMENTS:							
COMPONENT STATUS (Date & initial each item when complete)							
Tag Number	Delivered	Tag ID Checked	Installation	Termination Wiring	Termination Tubing	Calibration	
REMARKS:							
Loop Ready for Operation		By:		Date:		Loop No.:	

INSTRUMENT CALIBRATION SHEET

COMPONENT			MANUFACTURER			PROJECT						
Code:			Name:			Number:						
Name:			Model:			Name:						
			Serial #:									
FUNCTIONS												
	RANGE	VALUE	UNITS	COMPUTING FUNCTIONS? Y / N			CONTROL? Y / N					
Indicate? Y / N Record? Y / N	Chart:			Describe:			Action? direct / reverse Modes? P / I / D					
	Scale:						SWITCH? Y / N					
Transmit/ Convert? Y / N	Input:						Unit Range:					
	Output:						Differential: fixed/adjustable					
Reset? automatic / manual												
ANALOG CALIBRATIONS						DISCRETE CALIBRATIONS				Note. No		
REQUIRED			AS CALIBRATED			REQUIRED			AS CALIBRATED			
Input	Indicated	Output	Increasing Input		Decreasing Input		Number	Trip Point	Reset Pt.		Trip Point	Reset Pt.
			Indicated	Output	Indicated	Output						
							1.					
							2.					
							3.					
							4.					
							5.					
							6.					
CONTROL MODE SETTINGS:			P:	I:	D:		7.					
#	NOTES:								Component Calibrated and Ready for Start-up			
									By:			
									Date:			
									Tag No.:			

SECTION 17040 - CONTROL AND INFORMATION SYSTEM TRAINING REQUIREMENTS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. To familiarize the Owner's personnel with the process control system and field instrumentation, training shall be provided as detailed hereunder.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Control and Information System

1.03 SUBMITTALS

- A. A minimum of 60 days prior to beginning training, submit a detailed training plan describing the following:
 - 1. A listing of all courses to be conducted.
 - 2. Course content.
 - 3. Applicability of each course to management, operations, maintenance, laboratory, etc., personnel.
 - 4. Course schedules.
 - 5. Qualifications and experience of individual(s) providing training.
- B. A minimum of 14 days prior to beginning each training course, submit documentation for use by the Owner's personnel during training. The training documentation shall be specific to the particular course, and shall include the following:
 - 1. A listing of all subjects to be covered.
 - 2. Course schedule.
 - 3. Documentation/lesson plans covering all subjects to be covered during the course instruction. Information shall be in a "how to" format, with sufficient background documentation and references to manufacturer literature to provide a thorough and clear understanding of the materials to be covered.

1.04 GENERAL REQUIREMENTS

- A. All costs of providing the training courses shall be borne by the Contractor.
- B. As used herein, the term "day" shall mean an eight-hour day, and the term "week" shall mean a five day, 40 hour week.
- C. Training courses, especially those for operator training, may be required to be scheduled during non-standard business hours (i.e., not between the hours of 8:00 am and 5:00 pm)

to accommodate the working schedule of the Owner's personnel. No additional compensation will be awarded to the Contractor for training at non-standard hours.

- D. All training courses shall complement the experience and skill levels of the Owner's personnel.
- E. Training courses shall be structured in order of increasing capability or security levels. The purpose of this requirement is to allow personnel with lesser training requirements or security password levels to drop out of the training at certain times while the training continues for personnel with greater requirements or higher security levels.
- F. All training courses shall include lecture as well as "hands on" experience for each of the attending personnel. The Contractor shall provide sufficient equipment for this to be accomplished. For example, training in which the instructor uses the computer and the Owner's personnel passively observe as the instructor demonstrates system functions shall not be acceptable.
- G. Unless otherwise specified, all training courses shall be conducted in the Owner's facilities.
- H. All training shall be completed prior to system acceptance.
- I. Standard manufacturer training courses are acceptable pending approval by the Engineer and Owner.

1.05 OPERATOR TRAINING

- A. Two 1-hour courses for up to five persons each shall be conducted to provide instruction in the use of the Control and Information System to monitor and control the facility.
- B. Operator training shall include familiarization training covering the Control and Information System. Operators shall be instructed in the names, locations, functions, and basic operation of all items of digital equipment and associated software.
- C. Operator training shall cover process and equipment operation both individually and collectively as an operating system. Normal as well as abnormal operating conditions shall be covered, including the response to failure occurrences and system alarms. All operator/system interactions shall be described.
- D. Operators shall be trained to instruct other operators and shall be provided with all course materials.

1.06 INSTRUMENT TRAINING

- A. A half-day course shall be provided at the OWNER's facilities no more than 30 days prior to system start-up to instruct a minimum of five persons in the calibration and preventive maintenance of the field instruments provided under this Contract.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

- END OF SECTION -

SECTION 17060 - SIGNAL COORDINATION REQUIREMENTS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall conform to the signal coordination requirements specified herein.
- B. The Contractor shall be responsible for coordinating signal types and transmission requirements between the various parties providing equipment under this Contract. This shall include, but not be limited to, distribution of appropriate shop drawings among the equipment suppliers, the electrical subcontractor, and the instrumentation subcontractor.
- C. Analog signals shall be signals for transmitting process variables, etc. from instruments and to and from panels.
- D. Discrete signals shall consist of contact closures or powered signals for transmitting status/alarm information and control commands between starters, panels, equipment, the Control System, etc.

1.02 ANALOG SIGNAL TRANSMISSION

- A. Signal transmission between electric or electronic instruments, controllers, and all equipment and control devices shall be individually isolated, linear 4-20 milliamperes and shall operate at 24 volts D.C.
- B. Signal output from all transmitters and controllers shall be current regulated and shall not be affected by changes in load resistance within the unit's rating.
- C. All cable shields shall be grounded at one end only, at the control panel, with terminals bonded to the panel ground bus.
- D. Analog signal isolation and/or conversion shall be provided where necessary to interface with instrumentation, equipment controls, panels, and appurtenances.
- E. Non-standard transmission systems such as pulse duration, pulse rate, and voltage regulated shall not be permitted except where specifically noted in the Contract Documents. Where transmitters with nonstandard outputs do occur, their outputs shall be converted to an isolated, linear, 4-20 milliampere signal.
- F. The Contractor shall provide 24 V power supplies for analog signals and instruments where applicable and as required inside panels, controls, etc.
- G. Where two-wire instruments transmit directly to the Control and Information System, the instrumentation subcontractor shall provide power supplies at the PLC/RTU-equipped control panels for those instruments.
- H. Where four-wire instruments with on-board loop power supplies transmit directly to the Control and Information System, the instrumentation subcontractor shall provide

necessary signal isolators or shall otherwise isolate the input from the Control and Information System loop power supply. Similar provisions shall be made when a third element such as a recorder, indicator, or single loop controller with integral loop power supply is included in the loop.

1.03 DISCRETE INPUTS

- A. All discrete inputs to equipment and Control and Information System PLC/RTU's, from field devices, starters, panels, etc., shall be unpowered (dry) contacts in the field device or equipment, powered from the PLC/RTU's, unless specified otherwise.
- B. Sensing power (wetting voltage) supplied by the PLC/RTU shall be 24 VDC.

1.04 DISCRETE OUTPUTS

- A. All discrete outputs from local control panels and Control and Information System PLC/RTU's to field devices, starters, panels, etc., shall be 24 VDC powered (sourced) from the PLC/RTU panel.
- B. PLC/RTU powered discrete outputs shall energize 24 VDC pilot relay coils in the field devices, starters, panels, etc. which in turn open or close contacts in the associated control circuit. The 24 VDC relay coil, contacts, and associated control circuitry shall be furnished integral with the field device, starter, panel, etc. by the supplier and contractor furnishing the field device, starter, or panel.
- C. Where required or specified herein, discrete outputs from equipment and Control and Information System PLC/RTU's to field devices, starters, panels, motor operated valves, etc., shall be dry contact or relay outputs.
- D. Outputs to solenoid valves shall be 120 VAC, powered from the PLC/RTU or control panel unless specified or shown otherwise.

1.05 OTHER DISCRETE SIGNALS

- A. Discrete signals between starters, panels, etc. where no 24 VDC power supply is available may be 120 VAC, as long as such contacts are clearly identified in the starter, panel, etc. as being powered from a different power supply than other starter/panel components.
- B. Where applicable, warning signs shall be affixed inside the starter, panel, etc. stating that the panel is energized from multiple sources.
- C. Output contacts in the starter, panel, etc., that are powered from other locations shall be provided with special tags and/or color-coding. Disconnecting terminal strips shall be provided for such contacts.
- D. The above requirements shall apply to all starters and panels, regardless of supplier.

PART 2 -- PRODUCTS

2.01 PILOT RELAYS

- A. Pilot relays shall be supplied with the following:
 - 1. 24 VDC or 120 VAC coils, as required.
 - 2. At a minimum, DPDT contacts rated at 5 A, 120 VAC or 28 VDC.
 - 3. Sockets for 24 VDC and 120 VAC relays shall be of different configurations.
 - 4. Clips for attachment to sockets.
 - 5. Indicator lights that glow when the relay coil is powered.
- B. Pilot relays shall be as manufactured by Square D, Allen Bradley, Potter & Brumfield, or equal.

PART 3 – EXECUTION (NOT USED)

- END OF SECTION -

SECTION 17070 - CONTROL AND INFORMATION SYSTEM TESTING - GENERAL

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall test the Control and Information System as specified herein to demonstrate compliance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Control and Information System, General
- B. Field Testing
- C. Final Acceptance Test

1.03 SUBMITTALS

- A. For each of the specified tests, submit a test plan to the Engineer at least one month in advance of commencement of the tests. The test plan shall contain the following at a minimum:
 - 1. A schedule of all testing to be conducted.
 - 2. A brief description of the testing to be performed
 - 3. Test objectives.
 - 4. Testing criteria per the Specifications.
 - 5. Check lists and procedures for performing each of the specified tests.
 - 6. Sample test result documentation.
 - 7. Requirements for other parties.

1.04 GENERAL REQUIREMENTS

- A. All system start-up and test activities shall follow detailed test procedures; check lists, etc., previously approved by the Engineer. The Engineer shall be notified at least 21 days in advance of any system tests and reserves the right to have his and/or the Owner's representatives in attendance.
- B. The Contractor shall provide the services of experienced factory trained technicians, tools and equipment to field calibrate, test, inspect, and adjust all equipment in accordance with manufacturer's specifications and instructions.
- C. The Contractor (or designee) shall maintain master logbooks for each phase of installation, startup and testing activities specified herein. Each logbook shall include signal, loop or control strategy tag number, equipment identification, description and space for sign-off dates, Contractor signature and Engineer signature. Example test

documentation specific to each phase of testing shall be approved prior to initiation of that testing, as specified hereinabove.

- D. All test data shall be recorded on test forms, previously approved by the Engineer. When each test has been successfully completed, a certified copy of all test results shall be furnished to the Engineer together with a clear and unequivocal statement that all specified test requirements have been met and that the system is operating in accordance with the Contract Documents.
- E. The Engineer will review test documentation in accordance with the Contract Documents and will give written notice of the acceptability of the tests within 10 days of receipt of the test results.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

- END OF SECTION -

SECTION 17072 - FIELD TESTING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall perform field testing on the Control and Information System as specified herein to demonstrate compliance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Control and Information System
- B. Control and Information System Testing, General

1.03 GENERAL REQUIREMENTS

- A. Control system start-up and testing shall be performed to ensure that all plant processes shall be systematically and safely placed under digital control in the following order:
 - 1. Primary elements such as transmitters and switch devices shall be calibrated and tested as specified in applicable Section of Division 17.
 - 2. Each final control element shall be individually tested as specified hereinafter.
 - 3. Each control loop shall be tested as specified hereinafter.
 - 4. Each control strategy shall be tested under automatic digital control as specified hereinafter.
 - 5. The entire control system shall be tested for overall monitoring, control, communication, and information management functions, and demonstrated for system availability as specified hereinafter.
- B. System start-up and test activities shall include the use of water, if necessary, to establish service conditions that simulate, to the greatest extent possible, normal operating conditions in terms of applied process loads, operating ranges and environmental conditions.
- C. Each phase of testing shall be fully and successfully completed and all associated documentation submitted and approved prior to the next phase being started. Specific exceptions are allowed if written approval has been obtained in advance from the Engineer.

1.04 CONTRACTOR'S RESPONSIBILITIES

- A. The Contractor shall ensure that all mechanical equipment, equipment control panels, local control panels, field instrumentation, control system equipment and related equipment and/or systems are tested for proper installation, adjusted and calibrated on a loop-by-loop basis prior to control system startup to verify that each is ready to function

as specified. Each test shall be witnessed, dated and signed off by both the Contractor and the Engineer upon satisfactory completion.

- B. The Contractor shall be responsible for coordination of meetings with all affected trades. A meeting shall be held each morning to review the day's test schedule with all affected trades. Similarly, a meeting shall be held each evening to review the day's test results and to review or revise the next day's test schedule as appropriate.
- C. The Contractor shall ensure that the electrical subcontractor conforms to the start-up, test and sign-off procedures specified herein to assure proper function and coordination of all motor control center control and interlock circuitry and the transmission of all discrete and/or analog signals between equipment furnished by the electrical subcontractor and the control system specified herein.

1.05 FINAL CONTROL ELEMENT TESTING

- A. The proper control of all final control elements shall be verified by tests conducted in accordance with the requirements specified herein.
- B. All modulating final control elements shall be tested for appropriate speed or position response by applying power and input demand signals, and observing the equipment for proper direction and level of reaction. Each final control element shall be tested at 0, 25, 50, 75, and 100 percent of signal input level and the results checked against specified accuracy tolerances. Final control elements, such as VFD's, that require turndown limits shall be initially set during this test.
- C. All non-modulating final control elements shall be tested for appropriate position response by applying and simulating control signals, and observing the equipment for proper reaction.

1.06 LOOP CHECKOUT

- A. Prior to control system startup and testing, each monitoring and control loop shall be tested on an individual basis from the primary element to the final element, including the operator workstation or loop controller level, for continuity and for proper operation and calibration.
- B. Signals from transducers, sensors, and transmitters shall be utilized to verify control responses. Simulated input data signals may be used subject to prior written approval by the Engineer. All modes of control shall be exercised and checked for proper operation.
- C. The accuracy of all DAC's shall be verified by manually entering engineering unit data values at the operator workstation and then reading and recording the resulting analog output data.
- D. The accuracy of all ADC's shall be verified using field inputs or by manually applying input signals at the final controller, and then reading and recording the resulting analog input data at the operator workstation.
- E. Each loop tested shall be witnessed, dated and signed off by both the Contractor (or designee) and the Engineer upon satisfactory completion.

1.07 CONTROL SYSTEM STARTUP AND TESTING

- A. Control system startup and testing shall be performed to demonstrate complete compliance with all specified functional and operational requirements. Testing activities shall include the simulation of both normal and abnormal operating conditions.
- B. All digital hardware shall be fully inspected and tested for function, operation and continuity of circuits. All diagnostic programs shall be run to verify the proper operation of all digital equipment.
- C. Final control elements and ancillary equipment shall be tested under start-up and steady-state operating conditions to verify that proper and stable control is achieved using local area control panels, motor control center circuits, and local field mounted control circuits. All hardwired control circuit interlocks and alarms shall be operational. The control to final control elements and ancillary equipment shall be tested using both manual and automatic (where provided) control circuits.
- D. Signals from transducers, sensors, and transmitters shall be utilized to verify control responses for final control elements. Simulated input data signals may be used subject to prior written approval by the Engineer.
- E. Each control strategy shall be tested to verify the proper operation of all required functions. The control system start-up and test activities shall include procedures for tuning all control loops incorporating PID control modules, and for adjusting and testing all control loops as required to verify specified performance.
- F. The control system start-up and test activities shall include running tests to prove that the Instrumentation, Control and Information System is capable of continuously, safely and reliably regulating processes, as required by the Contract, under service conditions that simulate, to the greatest extent possible, normal plant operating ranges and environmental conditions.
- G. A witnessed functional acceptance test shall be performed to demonstrate satisfactory performance of individual monitoring and control loops and control strategies. At least one test shall be performed to verify that the control and instrumentation system is capable of simultaneously implementing all specified operations.
- H. Each loop and control strategy test shall be witnessed and signed off by both the Contractor and the Engineer upon satisfactory completion.

1.08 FACILITY STARTUP COORDINATION

- A. Facility start-up shall comply with requirements specified in the Contract Documents and those requirements specified herein. Facility start-up shall commence after all previously described start-up and test activities have been successfully completed and shall demonstrate that the Instrumentation, Control and Information System can meet all Contract requirements with equipment operating over full operating ranges under actual operating conditions.
- B. The control system start-up period shall be coordinated with process startup activities and shall be extended as required until all plant processes are fully operational and to satisfy

the Engineer that all control system Contract requirements have been fulfilled in accordance with the Contract Documents.

- C. The instrumentation subcontractor's personnel shall be resident at the facility to provide both full time (eight hours/day, five days/week) and 24 hours on call (seven days/week) support of operating and maintenance activities for the duration of the start-up period.
- D. At least one qualified control systems technician shall be provided for control system startup and test activities (at least two when loop checkout is being performed).

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

- END OF SECTION -

SECTION 17132 - REMOTE TERMINAL UNIT

PART 1 GENERAL

1.01 THE REQUIREMENT

- A. The specific attention of the Contractor is directed to the fact that the Owner has an existing TAC II SCADA System manufactured by Data Flow Systems, Inc. (DFS), of Melbourne, Florida (321) 259-5009. For compatibility purposes, the Contractor will be required to obtain the Remote Terminal Unit (RTU) specified herein from DFS.
- B. The Contractor shall coordinate tower and antenna requirements with DFS and shall provide station(s) physical location information to DFS for radio communication study purposes. Information shall be provided in the form of GPS readings or street map with actual site location(s) clearly marked. A complete radio survey shall be conducted by DFS to verify antenna and tower height requirements. DFS shall license the new RTU with the FCC for operation under the existing radio frequency.
- C. These specifications are intended to cover the furnishing, the shop testing, the delivery, complete installation and field testing of all equipment and appurtenances for the complete RTU system herein specified, whether specifically mentioned in the Specifications or not.
- D. The unit shall be furnished and installed with all necessary and desirable accessory equipment and auxiliaries whether specifically mentioned in these specifications or not. This installation shall include field-testing of the entire installation.
- E. The RTU shall be supplied with a NEMA 4X enclosure and mounted as shown on the Drawings. The RTU shall support the input/output signals specified in Section 17920.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 - Control and Information System Scope and General Requirements
- B. Section 17560 – Transient Voltage Surge Suppression Devices
- C. Section 17920 – Control System Input/Output Schedules

PART 2 PRODUCTS

2.01 REMOTE TERMINAL UNIT (RTU)

- A. The remote terminal unit shall be a PLC based data collection and dissemination subsystem. The remote terminal unit shall communicate with the central site (or forwarding terminal unit) via a Data Flow Systems two-way radio link and shall be designed to accommodate plug-in function modules. Function module card connectors shall be gold-over-nickel plated to inhibit corrosion. The RTU shall be capable of operating in a temperature ranging from -10 to 60 Degrees Celsius (14 to 140 Degrees Fahrenheit). The RTUs shall meet or exceed the quality, reliability, performance and versatility of those manufactured by Data Flow Systems, Inc. of Melbourne, Florida.

2.02 RTU SERIAL INTERFACE PORTS

- A. The remote terminal unit shall support one or more local serial interface ports. The local serial interface shall provide local access to all the functions of the remote terminal unit. The local serial interface shall support the monitoring of the radio communications link. The system shall support an automatic antenna alignment function utilizing the local serial interface.
- B. The PLC specified herein shall communicate all input/output signal data with the RTU via an RS-485 serial communications link as shown on Drawing I-02.

2.03 RTU POWER SUPPLY

- A. All function modules in the remote terminal unit shall run off DC voltage from +7.5 volts to +13 volts. The power supply module shall supply +12 volts. A battery backup shall be provided to operate the system for a minimum of 120 minutes in event of power failure. The power supply shall be surge protected. The power supply shall be short circuit protected by current limiting. Normal operation shall automatically resume when the short circuit overload is removed. The power supply shall be sized to operate the system with the battery removed. The power supply module shall provide a battery backed, isolated bias voltage source. The isolated bias voltage source shall be utilized to monitor the high well alarm so as to make sure the alarm is detected and reported during power outages. The circuit breaker for the power supply module shall be part of the power supply module. Neither the use of tools nor the disconnection of any wires shall be required to replace the power supply module.

2.04 RTU SURGE PROTECTION

- A. Multiple staged surge protection shall be provided for all power supply and power monitoring circuits. One stage of protection shall be equipped with both energy limiting and clamping circuits with slow blow fuses designed for overload conditions. This design shall provide a very high level of non-destructive transient immunity. With the exception of a direct lightning strike, the device shall protect the RTU power supply and power monitoring circuits from damage due to voltage transients. The unit shall provide circuit protection to withstand multiple transients in excess of 6,500 volts, 3,250 amps, without damage. Damage shall be limited to a blown fuse when exposed to larger transients. The device shall be transient-tested to ANSI standard C62.41. The unit shall meet or exceed the quality, reliability and performance of the Transient Filter Shield TFS001 as manufactured by Data Flow Systems. The AC power input protection shall meet or exceed the quality, reliability and performance of the Single Phase Suppressor, SPS001 (or, if three phase power is in use, the Three Phase Suppressor, TPS001) as manufactured by Data Flow Systems. See Section 17560 for additional requirements.

2.05 RTU BATTERIES

- A. The RTU shall have the uninterruptible power supply (UPS) function built in. The unit's internal power supply shall keep the batteries at a float charge. The batteries shall not be damaged by deep discharges.

2.06 PROGRAMABLE LOGIC CONTROLLERS (PLC)

- A. Provide a PLC in the RTU enclosure that shall function as the main controller for the RTU. All Well Pump Local Control Panel LCP-0109 input and output signals shall be wired to the PLC I/O. The PLC shall send well pump and well instrumentation status signals to the DFS RTU radio interface module and shall receive remote control signals from the DFS RTU radio interface module via RS-485 serial communications.
- B. Provide all PLC programming required for a fully functioning RTU system. PLC logic shall be well organized with detailed documentation of all PLC logic segment functionality clearly defined within the logic file.
- C. The PLC shall be equipped with 12 digital fast 24V dc inputs, 8 digital normal 24V dc inputs, 12 relays outputs, 4 Analog (12 bits) inputs, 2 Analog (12 bits) outputs and shall be supplied by 110/240V AC power. The PLC shall be an Allen-Bradley MicroLogix 1400, model 1766-L32BWAA as manufactured by Rockwell Automation. Provide 1762 Series Expansion I/O modules as required to meet all primary and spare PLC I/O requirements. Refer to Section 17920 for input/output requirements.
- D. All PLC 4-20mA analog inputs connected to field instruments shall be surge protected by analog surge suppressors. See Section 17560 for surge suppressor requirements.
- E. Provide a minimum of 20% active, prewired spare digital and analog PLC outputs and inputs with all required fuses and surge suppression.
- F. Provide redundant 120Vac to 24Vdc control power supplies with auto-failover as required.
- G. Provide a 120Vac UPS with minimum 10 minutes of PLC backup time and UPS common fault status output wired to a PLC digital input.

2.07 RTU RADIO INTERFACE MODULE

- A. Each remote terminal unit utilizing radio communications shall require one radio interface module (RIM). The RIM shall control the terminal radio during the polling sequence. The radio interface module shall have a service port to provide communications link monitoring. The service port shall also provide the capability to directly monitor and/or control each module in the remote terminal unit. The radio interface module utilized at the remote terminal units shall be interchangeable with the radio interface module at the central site. The system shall be capable of utilizing up to 505 radio interface modules per communications link and up to 15 function modules per radio interface module. All communications shall be in ASCII and utilize an error detecting and correction data transfer protocol. Each radio interface module shall have a radio transceiver mounted to it. The radio shall be an FM transceiver. The radio interface module shall measure and transmit to the central site computer system the received signal strength (RSS). Replacement of the radio interface module shall trigger an automatic configuration of the new module to accommodate the site address and function (plug & play).

2.08 ENCLOSURES

- A. Each RTU shall be housed in a NEMA 4X-316 stainless steel enclosure with removable steel lifting eyes, drip shields and sunshields. Both the enclosure and sunshields shall be polyester powder coated white.

- B. The enclosure shall be no more than 36 inches in width. Other panel dimensions shall be increased as required to allow for proper heat dissipation to ensure that enclosure internal temperature does not exceed the limits of any of the hardware inside the RTU enclosure, including, but not limited to the RTU radio, PLC, UPS and DC power supplies.
- C. All mounting hardware utilized shall be stainless steel.
- D. The enclosure door shall be equipped with a 3-point latching mechanism with a pad lockable handle. A foldable laptop shelf and a sleeve with a laminated copy of the final as-built RTU electrical schematics shall be mounted on the inside of the enclosure door.
- E. The enclosure shall have a Hoffman H20MIT vent drain, catalog number: AVDR4SS4 or approved equal at the bottom corner of the control panel. Vent drain shall be NEMA 4X stainless steel type.
- F. Provide a 120Vac service receptacle.
- G. Provide a PaneLite LED Enclosure Light, as manufactured by Hoffman. The panel light shall be wired to turn on when the intrusion switch is activated (door is open).
- H. Refer to Electrical Drawings for additional requirements.

2.09 ANTENNA SUBSYSTEM

- A. A high gain directional antenna shall be used to transmit and receive data at the Remote Terminal Units. The directional antennas shall have all welded aluminum elements, and a single radiator element connected to a type N female connector. Element connections utilizing nuts and bolts are not acceptable. The antennas shall meet or exceed the quality, reliability and performance of the RTA series as provided by Data Flow Systems, Inc. of Melbourne, Florida. When an antenna mast/pole is utilized, it shall be hot dipped galvanized for corrosion protection. All mounting hardware shall be made of stainless steel. The mast shall meet or exceed the quality and reliability of the AG20 manufactured by Rohn. The coax cable shall be the type that utilizes an inert semi-liquid compound to flood the copper braid. The coax cable shall be of the RG-8 construction type and have the RF-loss characteristic of foam flex. The coax cable shall meet or exceed the quality, reliability and performance of RTC 400 as supplied by Data Flow Systems, Inc. of Melbourne, Florida. Type N connectors shall be utilized at both ends of the coax. The Type N connectors shall be sealed with 3-inch sections of Alpha FIT321-1-0 sealant shrink tubing. The coax cable shall be secured to the mast/pole with EVA-coated 316 stainless steel cable ties. The cable ties shall meet or exceed the quality, reliability and performance of AE112 cable ties manufactured by Band-It. The RTU shall be protected from electrical surge or transients entering through the coaxial cable by use of a coaxial cable surge protector. The coaxial cable surge protector shall meet or exceed the quality, reliability and performance of the IS-B50LN-C2 manufactured by Polyphaser.

2.10 WARRANTY

- A. The system supplier shall warrant all hardware and RTU SCADA software provided under this contract against all defects in material and workmanship for a period of one year. The system supplier shall warrant the SCADA software to be free of defects for as long as it is in operation by the Owner. The RTU supplier shall also provide free RTU SCADA

Software updates for the life of the system. The function modules utilized in the remote terminal units shall carry an additional 2-year return-to-factory warranty. The 2-year return-to-factory warranty shall cover damage due to lightning and surge.

2.11 SERVICE

- A. The system supplier shall offer full factory support of the installed system through the use of factory-trained employees. The Owner shall have 24-hour per day access to service personnel through a pager and/or cell phone.

2.12 SPARES

- A. One spare of each type of Data Flow System module supplied, including but not limited to radio interface modules, controllers and serial communications modules.
- B. Provide one spare of each type of Data Flow Systems backup battery.
- C. One spare complete PLC with CPU and all required expansion I/O modules shall be supplied. The current PLC logic program shall pre-loaded on the spare PLC CPU.
- D. One spare 24VDC control power supply.
- E. One spare main AC input surge suppressor.
- F. Three spare PLC analog input surge suppressors.
- G. Five spare fuses of each make/model provided.

PART 3 EXECUTION

(NOT USED)

- END OF SECTION -

SECTION 17560 - TRANSIENT VOLTAGE SURGE SUPPRESSION DEVICES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, install and place in satisfactory operation the transient voltage surge suppression (TVSS) devices as specified herein and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Control and Information System
- B. Control and Information System Hardware, General

1.03 GENERAL INFORMATION AND DESCRIPTION

- A. All surge protectors of each type provided under this Contract shall be furnished by a single manufacturer.

1.04 TOOLS, SUPPLIES AND SPARE PARTS

- A. The following specific spare parts items shall be provided:
 - 1. One of each type of transient voltage surge suppression (TVSS) devices provided under this Contract.

PART 2 -- PRODUCTS

2.01 ELECTRICAL TRANSIENT PROTECTION, GENERAL

- A. All electrical and electronic elements shall be protected against damage due to electrical transients induced in interconnecting lines from lightning discharges and nearby electrical systems.
- B. Manufacturer's Requirements: All transient voltage surge suppressor devices shall be multi stage serial devices manufactured by a company that has been engaged in the design, development, and manufacture of such devices for at least 5 years. Acceptable manufacturers shall be Phoenix Contact, EDCO, or equal.
- C. Surge protection device installations shall comply with UL 94, the National Electric Code (NEC), and all applicable local codes.
- D. Surge protection devices shall be installed as close to the equipment to be protected as practically possible.
- E. Suppressor Locations: As a minimum, provide surge suppressors at the following locations:
 - 1. At all connections between AC power, DC power and associated electrical and electronic equipment, including panels, cabinets, rack assemblies, and field mounted powered instruments.
 - 2. At both ends of all two-wire analog signal circuits and all four wire analog power/signal circuits.
 - 3. At the panel end of all 24 VDC or 120 VAC discrete input (dry contact) and discrete output circuits.
 - 4. At each device termination point of copper-based communication cables (e.g., serial, parallel, Ethernet, Device Net, etc.).

5. On all telephone communications lines.
 6. RF antenna cable radio terminus.
- F. All indoor and outdoor panels, racks and enclosures shall contain multi-stage surge suppression devices which shall be integral with the terminal block assembly as a complete surge protection system. Systems shall be DIN rail mounted of modular design for field replacement without the need to remove terminated wiring. System shall be Phoenix Contact PLUGTRAB series, or equal.
- G. Surge protectors shall be as follows:
1. 120-Volt field mounted analog transmitter. The protector shall combine AC power protection and 4-20 mA signal line protection. The suppressor shall be EDCO series SLAC or equal.
 2. Field mounted 120-Volt power surge suppressor shall be EDCO series HSP121BT or equal.
 3. Panel mounted 120-volt power surge suppression shall be Phoenix PLUGTRAB, or equal.
 4. Two and four wire 4-20 mA analog signal line and power protection at the panel side shall be Phoenix PLUGTRAB, or equal.
 5. Field mounted two and four wire field mounted 4-20 mA analog signal line and power protection shall be JOSLYN model 1669-06, EDCO, or equal.
 6. Two wire discrete input/output signal line protection at the panel side shall be Phoenix PLUGTRAB, or equal.
 7. Non-fiber optic data networks (serial, parallel, Ethernet, Profibus, Device Net telephone, etc.) shall include signal line protection at each device termination point. Phoenix PLUGTRAB, or equal.

2.02 AC POWER PROTECTION CHARACTERISTICS

- A. Surge suppressor assemblies for connections to AC power supply circuits shall be assemblies that:
1. Are constructed as multistage devices consisting of gas tube arrestors, high energy metal oxide varistors, or silicon avalanche suppression diodes. Suppressor assemblies shall automatically recover from surge events.
 2. Comply with all requirements of UL 1449, second edition and meet or exceed the following performance criteria based on a test surge wave shape with an 8-microsecond rise time and a 20-microsecond exponential decay time:
 - a. Minimum Operating Voltage: 130V ac
 - b. Maximum Breakdown Voltage: 150V ac
 - c. Maximum Operating Current: 15 amps
 - d. Peak First Stage Surge Current: 20,000 amps
 - e. Maximum First Stage Clamping Voltage: 350 volts
 - f. Maximum Second Stage Clamping Voltage: 210 volts
 - g. Ambient Temperature Range: -20 degrees C to +85 degrees C

2.03 ANALOG SIGNAL CIRCUIT PROTECTION CHARACTERISTICS

A. Surge suppressors for analog signal circuits shall:

1. Limit line-to-ground and line-to-line voltage to 33 volts on 24V dc circuits.
2. Meet or exceed the following performance criteria based on a test surge wave with 8-microsecond rise time and 20-microsecond exponential decay time:
 - a. Recovery: Automatic
 - b. Peak Source Current: 10,000 amps
 - c. Pulse Lift Before Failure: 100 occurrences
 - d. Minimum Voltage Clamp Rating: 33 volts
 - e. Series Impedance: 24 ohms total
 - f. Temperature Range: -20 degrees C to +85 degrees C
 - g. Operating Voltage: Less than 30V dc
 - h. Operating Current: 4 to 20 mA dc
 - i. Resistance Line-to-Ground: Greater than 1 megohm

2.04 DISCRETE SIGNAL CIRCUIT PROTECTION CHARACTERISTICS

A. Surge suppressors for analog signal circuits shall:

1. Limit line-to-ground and line-to-line voltage to 60 volts on 24V dc circuits.
2. Meet or exceed the following performance criteria based on a test surge wave with 8-microsecond rise time and 20-microsecond exponential decay time:
 - a. Recovery: Automatic
 - b. Peak Source Current: 10,000 amps
 - c. Pulse Lift Before Failure: 100 occurrences
 - d. Minimum Voltage Clamp Rating: 60 volts
 - e. Series Impedance: 15 ohms total
 - f. Temperature Range: -40 degrees C to +85 degrees C
 - g. Resistance Line-to-Ground: Greater than 1 megohm

2.05 COMMUNICATION CIRCUIT PROTECTION CHARACTERISTICS

A. Surge suppressors for copper-based data communication circuits shall:

1. Be designed for the specific data communication media and protocol to be protected (e.g., telephone, serial, parallel, Ethernet, DeviceNet, coax, twin-axial, twisted pair, RF, etc.).
2. Provide protection of equipment to within the equipment's surge withstand levels for applicable standard test wave forms of the following standards:
 - a. IEC 60-1 / DIN VDE 0432 part 2
 - b. CCITT K17 / DIN VDE 0845 part 2
 - c. IEEE C62.31

3. Provide automatic recovery.

PART 3 -- EXECUTION

3.01 REQUIREMENTS

- A. Install in accordance with manufacture recommended practices and applicable codes.

- END OF SECTION -

SECTION 17600 - UNPOWERED INSTRUMENTS - GENERAL

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, install, test and place in operation unpowered process instrumentation (flow elements, level switches, analysis elements, detectors, etc.) as shown on the Contract Drawings and as specified.
- B. It is the intent of this Specification and the Contract Documents that all process taps, isolation valves, nipples, penetrations, embedded instrumentation supports, conduit, wiring, terminations, and the installation of unpowered process instrumentation on process lines shall be provided under this Contract.
- C. Tappings and connections for primary process sensors shall be sized to suit each individual installation and the requirements of the instrument served. It is the Contractor's responsibility to ensure that the location, supports, orientation and dimensions of the connections and tappings for instrumentation furnished under this Division are such as to provide the proper bracing, the required accuracy of measurement, protection of the sensor from accidental damage and accessibility for maintenance while the plant is in operation. Isolation valves shall be provided at all process taps.

1.02 QUALITY ASSURANCE

- A. The following organizations have generated standards that are to be used as guides in assuring quality and reliability of components and systems; govern nomenclature and define parameters of configuration and construction:
 - 1. ISA - Instrument Society of America.
 - 2. OSHA - Occupational Safety and Health Administration.
 - 3. EPA - Environmental Protection Agency.
 - 4. ANSI - American National Standards Institute.
 - 5. Refer to Division 16 for additional electrical standards and requirements.

PART 2 -- PRODUCTS

2.01 GENERAL

- A. Unless otherwise specified, instruments shall be ruggedized construction of materials to suit specified environmental conditions. Instruments shall be rugged and mounted on walls, pipe stanchions on in-line as specified.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. General: Equipment shall be located so that it is accessible for operation and maintenance. The instrumentation subcontractor shall examine the Contract Drawings and shop drawings for various items of equipment in order to determine the best arrangement for the work as a whole, and shall supervise the installation of process instrumentation supplied under this Division.
- B. Equipment Mounting and Support:

1. Field equipment shall be wall mounted or mounted on two-inch diameter aluminum pipe stands welded to a 10-inch square ½-inch thick aluminum steel base plate unless shown adjacent to a wall or otherwise noted. Instruments attached directly to concrete shall be spaced out from the mounting surface not less than ½-inch by use of phenolic spacers. Expansion shields in walls shall be used for securing equipment or wall supports to concrete surfaces. Unless otherwise noted, field instruments shall be mounted between 48 and 60 inches above the floor or work platform.
2. Embedded pipe supports and sleeves shall be schedule 40, Type 304 stainless steel pipe, ASA B-36.19, with stainless steel blind flange for equipment mounting as shown on the Contract Drawings.
3. Materials for miscellaneous mounting brackets and supports shall be Type 304 stainless steel construction.
4. Pipe stands, miscellaneous mounting brackets and supports shall comply with the requirements of Division 5 of the Specifications.

3.02 ADJUSTMENT AND CLEANING

A. General

1. The Contractor shall comply with the requirements of Division 1 of these Specifications and all instrumentation and control system tests, inspection, and calibration requirements for all instrumentation and controls provided under this Contract and specified herein. The Engineer, or its designated representative(s), reserve the right to witness any test, inspection, calibration or start-up activity. Acceptance by the Engineer of any plan, report or documentation relating to any testing or commissioning activity specified herein shall not relieve the Contractor of its responsibility for meeting all specified requirements.
2. The Contractor shall provide the services of factory trained technicians, tools and equipment to field calibrate, test, inspect and adjust each instrument to its specified performance requirement in accordance with manufacturer's specifications and instructions. Any instrument which fails to meet any contract requirements, or any published manufacturer performance specification for functional and operational parameters, shall be repaired or replaced, at the discretion of the Engineer, at no cost to the Owner. The Contractor shall bear all costs and provide all personnel, equipment and materials necessary to implement all installation tests and inspection activities for equipment specified herein.
3. At least 60 days before the anticipated initiation of installation testing, the Contractor shall submit to the Engineer a detailed description, in duplicate, of the installation tests to be conducted to demonstrate the correct operation of the instrumentation and control system.

B. Calibration Requirements

1. The Contractor shall supply factory calibration data for Engineer's information and/or review for the following:
 - a. Instruments that are generally factory calibrated.
 - b. Instruments that are specified to be factory calibrated.
 - c. Instruments that have calibration curve based upon empirical data.

2. The Contractor shall provide the services of factory trained instrumentation technicians, tools and equipment to field calibrate each instrument supplied under this Contract to its specified accuracy in accordance with the manufacturer's specification and instructions for calibration.
3. Each instrument shall be calibrated at 10, 50 and 90 percent of span using test instruments to simulate inputs and read outputs. Test instruments shall be rated to an accuracy of at least five (5) times greater than the specified accuracy of the instrument being calibrated. Where applicable, such test instruments shall have accuracies as set forth by the National Bureau of Standards.
4. The Contractor shall provide a written calibration sheet to the Engineer for each instrument, certifying that it has been calibrated to its published specified accuracy. The Contractor shall submit proposal calibration sheets for various types of instruments for Engineer approval prior to the start of calibration. This sheet shall include but be limited to date, instrument tag numbers, calibration data for the various procedures described herein, name of person performing the calibration, a listing of the published specified accuracy, permissible tolerance at each point of calibration, calibration reading as finally adjusted within tolerance, defect noted, corrective action required and corrections made.
5. If doubt exists as to the correct method for calibrating or checking the calibration of an instrument, the manufacturer's printed recommendations shall be used as an acceptable standard, subject to the approval of the Engineer.
6. Upon completion of calibration, devices shall not be subjected to sudden movements, accelerations, or shocks, and shall be installed in permanent protected positions not subject to moisture, dirt, and excessive temperature variations. Caution shall be exercised to prevent such devices from being subjected to overvoltage, incorrect voltages, overpressure or incorrect air. Damaged equipment shall be replaced and recalibrated at no cost to the Owner.

- END OF SECTION -

SECTION 17650 - PRESSURE GAUGES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation the pressure gauges, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Control and Information System Scope and General Requirements
- B. Unpowered Instruments, General
- C. Instrumentation and Control System Accessories

PART 2 -- PRODUCTS

2.01 PRESSURE GAUGES

- A. All gauges shall be designed in accordance with the ASME B40.1 entitled, "Gauges, Pressure, Indicating Dial Type - Elastic Element".
- B. All gauges shall be direct reading type. Snubbers shall be provided on all gauges. Gauge full-scale pressure range shall be selected such that the maximum operating pressure shall not exceed the approximately 75% of the full-scale range.
- C. Features
 - 1. Mounting: ½-inch NPT, lower stem mount type
 - 2. Accuracy: 0.5% full scale
 - 3. Case: Solid front, black phenolic material
 - 4. Dial: White background and black letters
 - 5. Glass: Shatterproof
 - 6. Blow-out protection: Back
 - 7. Pressure element: stainless steel bourdon tube
 - 8. Movement: Stainless steel, Teflon coated pinion gear and segment
 - 9. Gaskets: Buna-N
- D. Liquid-filled or equivalent mechanically-damped gauges shall be used if the gauges are installed with pumps, or where gauges are subjected to vibrations or pulsation. Filling fluid shall be silicone unless oxidizing agents such as sodium hypochlorite are present, where halocarbon shall be used.
- E. Gauge size shall be 2-inch for line sizes up to 3-inch and 4½-inch for line sizes of 4-inch or greater.

- F. Diaphragm seals and isolating ring seals shall be furnished in accordance with the requirements specified under the Section entitled "Instrumentation and Control System Accessories".
- G. The complete gauge assembly and appurtenances shall be fully assembled and tested prior to field mounting. A ½-inch isolation stainless steel ball valve shall be provided for each gauge assembly.
- H. Pressure and vacuum gauges shall be Ashcroft Duragauge Model 1279, Ametek-U.S. Gauge Division, H.O. Trerice Co., WIKA Instrument Corporation, or equal.

PART 3 -- EXECUTION

3.01 REQUIREMENTS

- A. Refer to the Section entitled "Unpowered Instruments, General".

- END OF SECTION -

SECTION 17675
PRESSURE SWITCHES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation the pressure switches, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 - Control and Information System Scope and General Requirements
- B. Section 17600 - Unpowered Instruments, General

PART 2 -- PRODUCTS

2.01 PRESSURE SWITCHES

- A. Pressure, vacuum, and differential pressure switches shall be single or dual action with an adjustable setpoint for the process requirement and/or as specified herein. Switches shall be diaphragm or piston operated and activate S.P.D.T. snap action switches on increasing or decreasing pressure. Minimum differential shall be less than 10 percent of the range. Deadband shall be adjustable. Allowable surge pressure shall be a minimum 1.5 times the range. Each pressure switch shall have visible scale.
- B. Pressure switches shall have a contact rating of 10 amperes at 120 volts AC. Pressure switches shall be in NEMA 4X enclosures. Switches shall have a repeatable accuracy of 1 percent of range. Pressure switches shall be isolated from the process fluid by a diaphragm seal or an isolation ring in locations as shown on the Contract Drawings and/or as specified. Wetted parts materials shall be compatible with the process fluid for corrosion resistance. Pressure switches shall be manufactured by ASCO, SOR, Inc., Ashcroft, or equal.

PART 3 -- EXECUTION

3.01 REQUIREMENTS

- A. Refer to Section 17600 Part 3.

- END OF SECTION -

SECTION 17698 - INSTRUMENTATION AND CONTROL SYSTEM ACCESSORIES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation the instrumentation and control system accessories with all spare parts, and appurtenances as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Control and Information System, General
- B. Unpowered Instruments, General
- C. Powered Instruments, General

PART 2 -- PRODUCTS

2.01 INSTRUMENTATION AND CONTROL SYSTEM ACCESSORIES

- A. General: Accessories include various items of equipment that may be required in the system but are not scheduled. Accessories are shown on details, flow sheets or plans. Accessories are also called out in specifications for scheduled instruments and in the installation specifications. It is not intended, however, that each piece of hardware required will be specifically described herein. This subarticle shall be used as a guide to qualify requirements for miscellaneous hardware whether the specific item is described or not.
- B. Process Tubing: Process tubing shall be 1/2-inch x 0.065-inch seamless, annealed, ASTM A-269 Type 316L stainless steel with Type 316 - 37 degrees stainless steel flared fittings or Swagelock or Parker-CPI flareless fittings.
- C. Power, Control and Signal Cables: Power, control and signal wiring shall be provided under Division 16 of the Specifications.
- D. Chemical Diaphragm Seals: Diaphragm seals shall be provided for isolation of pressure gauges, switches and transmitters attached to systems containing chemical solutions or corrosive fluids. As a minimum, (unless specified otherwise) seals shall be of all Type 316 stainless steel construction. In general, diaphragms shall be metallic for operating pressures at or above 15 psi and elastomers for operating pressures below 15 psi. However, diaphragm material shall be non-reactive with the process fluid in all cases. Refer to the Instrument Schedules for specific materials requirements. Seal shall have fill connection, 1/4-inch NPT valved flush port and capable of disassembly without loss of filler fluid. Where specified, diaphragm seals shall comply with the above requirements and shall be provided with 316 SS factory filled capillaries. Seals shall be Helicoid Type 100 HA, Mansfield & Green, Ashcroft, or equal. Seals shall comply with the following materials of construction:

Application	Maximum Operating Pressure (PSI)	Diaphragm Material	Bottom Housing Material	Top Housing Material
Raw Water and Finished Water	150	316L Stainless Steel	316L Stainless Steel	316L Stainless Steel

- E. Isolating Ring Seals: For solids bearing fluids, line pressure shall be sensed by a flexible cylinder lining and transmitted via a captive sensing liquid to the associated pressure sensing instrument(s).
1. Full Line Size Isolating Ring Seals - Wherever the associated pressure instrument is used for control purposes, the sensor body shall be full line size wafer design. Except where noted on the Drawings and/or Instrument Schedule, full line size ring seals will have tapped ring seals as specified in Item 2, below. Full line size isolating ring seals shall have Type 316 stainless steel housing and assembly flanges and Buna N flexible cylinder lining for in-line mounting. The wafer shall have through bolt holes or centerline gauge for positive alignment with the associated flanged piping. The captive liquid chamber and associated instrument(s) shall be furnished with threaded drain tap and plug. Isolating ring seals shall be RED Valve Series 40, Ronningen-Petter Iso-Ring, Moyno RKL Series W, Onyx Isolator Ring, or equal.
 2. Tapped Isolating Ring Seals - For all other solids bearing fluids, pressure shall be sensed via a minimum ½-inch diameter spool-type isolating ring seal mounted on a ½-inch pipe nipple at 90 degrees from the process piping. An isolation ball valve shall be provided between the process piping and the ring seal, and a cleanout ball valve shall be provided between the ring seal and the atmosphere. The pressure instrument shall be back or side mounted to the ring seal such that the gauge or readout may be viewed normally. Tapped isolating ring seals for solids service shall be Red Valve Series 42/742, Ronningen-Petter Iso-Spool, Onyx Isolator Ring, or equal.
- F. Filling Medium: The filling medium between instruments, isolating ring seals and diaphragm seals shall be a liquid suitable for operation in an ambient temperature ranging from -10°F to +150°F. Filling medium shall be silicone unless oxidizing agents such as sodium hypochlorite are present, where halocarbon shall be used.
- G. Isolation Valves: Isolation valves shall be ½-inch diameter ball valves with Type 316 stainless steel body, Type 316 stainless steel ball, except that materials of construction shall be suitable for the associated process fluid where applicable (i.e., chemical service).
- H. Sirens: Sirens shall be UL Listed, heavy duty, AC motor driven, weatherproof type capable of producing a minimum of 111 dBA at 10 feet. Power supply shall be 120 VAC, 60 hertz. Siren shall be McMaster-Carr Model 6392T11, Federal Signal Corporation equivalent, Edwards Signaling Company equivalent, or equal.

- I. Strobe Lights: Strobe lights shall be high profile with Type 304 stainless steel base. Light is rated NEMA 4. Light shall have an outer dome to provide extra lens protection. Lens color shall be as indicated on the Drawings. Surface mount hardware shall be included. Power supply shall be 120 VAC, 60 hertz. Strobe light shall be McMaster-Carr Model 5848T71, Federal Signal Corporation equivalent, Edwards Signaling Company equivalent, or equal.

PART 3 – EXECUTION (NOT USED)

- END OF SECTION -

SECTION 17700 - POWERED INSTRUMENTS, GENERAL

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, install, test and place in operation powered process instrumentation (flow elements, level transmitters, etc.) as scheduled herein together with all signal converters, transmitters, isolators, amplifiers, etc. to interface all instrumentation, panels, controls and process equipment control panels with the process control system as shown on the Drawings and as specified. Powered instruments are those instruments which require power (120 VAC or 24 VDC loop power) to operate.
- B. It is the intent of this Specification and the Contract Documents that all process taps, isolation valves, nipples, penetrations, embedded instrumentation supports, conduit, wiring, terminations, and the installation of process instrumentation on process lines shall be provided under this Contract.
- C. Tappings and connections for primary process sensors shall be sized to suit each individual installation and the requirements of the instrument served. It is the Contractor's responsibility to ensure that the location, supports, orientation and dimensions of the connections and tappings for instrumentation furnished under this Division are such as to provide the proper bracing, the required accuracy of measurement, protection of the sensor from accidental damage, and accessibility for maintenance while the plant is in operation. Isolation valves shall be provided at all process taps.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Control and Information System
- B. Unpowered Instruments, General
- C. Powered instruments furnished with mechanical equipment shall be furnished, installed, tested and calibrated as specified elsewhere in the Contract Documents.

1.03 GENERAL INFORMATION AND DESCRIPTION

- A. These Specifications are intended to give a general description of what is required, but do not cover all details which will vary in accordance with the requirements of the equipment furnished. They are, however, intended to cover the furnishing, the shop testing, the delivery and complete installation and field testing, of all powered instruments and appurtenances whether specifically mentioned in the Specification or not.
- B. The powered instruments shall be furnished and installed with all necessary accessory equipment and auxiliaries whether specifically mentioned in these Specifications or not. These installations shall incorporate the highest standards for the type of service shown on the Drawings including loop testing of the entire installation and instruction of operating personnel in the care, operation, calibration and maintenance of all powered instrumentation.

- C. All the powered instrumentation shall be of first class workmanship and shall be entirely designed and suitable for the intended services. All materials used in fabricating the equipment shall be new and undamaged.

PART 2 -- PRODUCTS

2.01 GENERAL

- A. All instrumentation supplied shall be the manufacturer's latest design. Unless otherwise specified, instruments shall be solid state, electronic, using enclosures to suit specified environmental conditions. Microprocessor-based equipment shall be supplied unless otherwise specified. All instruments shall be provided with mounting hardware and floor stands, wall brackets, or instrument racks as shown on the Drawings, or as required.
- B. Equipment installed in a hazardous area shall meet Class, Group, and Division as shown on the Drawings, to comply with the National Electrical Code.
- C. All instruments shall return to accurate measurement without manual resetting upon restoration of power after a power failure.
- D. Unless otherwise shown or specified, local indicators shall be provided for all instruments. Where instruments are located in inaccessible locations, local indicators shall be provided and shall be mounted as specified in Subsection 3.01 (B) herein. All indicator readouts shall be linear in process units. Readouts of 0-100% shall not be acceptable (except for speed and valve position). Floating outputs shall be provided for all transmitters.
- E. Unless otherwise specified, field instrument and power supply enclosures shall be Type 316 stainless steel, fiberglass or PVC coated copper free cast aluminum NEMA 4X construction.
- F. Where separate elements and transmitters are required, they shall be fully matched, and unless otherwise noted, installed adjacent to the sensor. Special cables or equipment shall be supplied by the associated equipment manufacturer.
- G. Electronic equipment shall utilize printed circuitry and shall be coated (tropicalized) to prevent contamination by dust, moisture and fungus. Solid-state components shall be conservatively rated for long-term performance and dependability over ambient atmosphere fluctuations. Ambient conditions shall be -15 to 50 degrees C and 20 to 100 percent relative humidity, unless otherwise specified. Field mounted equipment and system components shall be designed for installation in dusty, humid, and corrosive service conditions.
- H. All devices furnished hereunder shall be heavy-duty type, designed for continuous industrial service. The system shall contain products of a single manufacturer, insofar as possible, and shall consist of equipment models which are currently in production. All equipment provided, where applicable, shall be of modular construction and shall be capable of field expansion.
- I. All non-loop-powered instruments and equipment shall be designed to operate on a 60 Hz alternating current power source at a nominal 117 V, plus or minus 10 percent, except where specifically noted. All regulators and power supplies required for compliance with

the above shall be provided. Where equipment requires voltage regulation, constant voltage transformers shall be supplied.

- J. All analog transmitter and controller outputs shall be isolated, 4-20 milliamps into a load of 0-750 ohms, unless specifically noted otherwise. All switches shall have double-pole, double-throw contacts rated at a minimum of 600 VA, unless specified otherwise.
- K. Materials and equipment used shall be U.L. approved wherever such approved equipment and materials are available.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. General

- 1. Equipment shall be located so that it is accessible for operation and maintenance. The Contractor shall examine the Drawings and Shop Drawings for various items of equipment in order to determine the best arrangement for the work as a whole, and shall supervise the installation of process instrumentation supplied under this Division.
- 2. Electrical work shall be performed in compliance with all applicable local codes and practices. Where these specifications and the Drawings do not delineate precise installation procedures, API RP550 shall be used as a guide to installation procedures.

B. Equipment Mounting and Support

- 1. Field equipment shall be wall mounted or mounted on 2-inch diameter aluminum pipe stands welded to a 10-inch square ½-inch thick aluminum base plate unless shown adjacent to a wall or otherwise noted. Instruments attached directly to concrete shall be spaced out from the mounting surface not less than ½-inch by use of phenolic spacers. Expansion anchors in walls shall be used for securing equipment or wall supports to concrete surfaces. Unless otherwise noted, field instruments shall be mounted between 48 and 60-inches above the floor or work platform.
- 2. Embedded pipe supports and sleeves shall be schedule 40, Type 316 stainless steel pipe, ASA B-36.19, with stainless steel blind flange for equipment mounting as shown on the Drawings.
- 3. Materials for miscellaneous mounting brackets and supports shall be Type 316 stainless steel construction.
- 4. Pipe stands, miscellaneous mounting brackets and supports shall comply with the requirements of Division 5 of the specifications.
- 5. Transmitters shall be oriented such that output indicators are readily visible.

- C. Control and Signal Wiring: Electrical, control and signal wiring connections to transmitters and elements mounted on process piping or equipment shall be made through liquid-tight

flexible conduit. Conduit seals shall be provided where conduits enter all field instrument enclosures and all cabinetry housing electrical or electronic equipment.

3.02 ADJUSTMENT AND CLEANING

A. General

1. The Contractor shall comply with the requirements of Division 1 of these Specifications and all instrumentation and control system tests, inspection, and calibration requirements for all instrumentation and controls provided under this Contract and specified herein. The Engineer, or its designated representative, reserves the right to witness any test, inspection, calibration or start-up activity. Acceptance by the Engineer of any plan, report or documentation relating to any testing or commissioning activity specified herein shall not relieve the Contractor of its responsibility for meeting all specified requirements.
2. The Contractor shall provide the services of factory trained technicians, tools and equipment to field calibrate, test, inspect and adjust each instrument to its specified performance requirement in accordance with manufacturer's specifications and instructions. Any instrument which fails to meet any contract requirements, or any published manufacturer performance specification for functional and operational parameters, shall be repaired or replaced, at the discretion of the Engineer, at no cost to the Owner. The Contractor shall bear all costs and provide all personnel, equipment and materials necessary to implement all installation tests and inspection activities for equipment specified herein.
3. At least 60 days before the anticipated initiation of installation testing, the Contractor shall submit to the Engineer a detailed description, in duplicate, of the installation tests to be conducted to demonstrate the correct operation of the instrumentation supplied hereunder.

B. Field Instrument Calibration Requirements

1. The Contractor shall provide the services of factory trained instrumentation technicians, tools and equipment to field calibrate each instrument supplied under this Contract to its specified accuracy in accordance with the manufacturer's specification and instructions for calibration.
2. Each instrument shall be calibrated at 0, 25, 50, 75 and 100 percent of span using test instruments to simulate inputs and read outputs. Test instruments shall be rated to an accuracy of at least five (5) times greater than the specified accuracy of the instrument being calibrated. Where applicable, such test instruments shall have accuracies as set forth by the National Institute for Standards and Technology (NIST).
3. The Contractor shall provide a written calibration sheet to the Engineer for each instrument, certifying that it has been calibrated to its published specified accuracy. The Contractor shall submit proposed calibration sheets for various types of instruments for Engineer approval prior to the start of calibration. This sheet shall include but be limited to date, instrument tag numbers, calibration data for the various procedures described herein, name of person performing the calibration,

a listing of the published specified accuracy, permissible tolerance at each point of calibration, calibration reading as finally adjusted within tolerance, defect noted, corrective action required and corrections made.

4. If doubt exists as to the correct method for calibrating or checking the calibration of an instrument, the manufacturer's printed recommendations shall be used as an acceptable standard, subject to the approval of the Engineer.
5. Upon completion of calibration, devices calibrated hereunder shall not be subjected to sudden movements, accelerations, or shocks, and shall be installed in permanent protected positions not subject to moisture, dirt, and excessive temperature variations. Caution shall be exercised to prevent such devices from being subjected to overvoltage, incorrect voltages, overpressure or incorrect air. Damaged equipment shall be replaced and recalibrated at no cost to the Owner.
6. After completion of instrumentation installation, the Contractor shall perform a loop check. The Contractor shall submit final loop test results with all instruments listed in the loop. Loop test results shall be signed by all representatives involved for each loop test.

- END OF SECTION -

SECTION 17701 - MAGNETIC FLOW METERS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation the magnetic flow meters, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Control and Information System, General
- B. Powered Instruments, General

PART 2 -- PRODUCTS

2.01 MAGNETIC FLOW METER SYSTEMS

- A. Magnetic flow meter systems shall include a magnetic flow tube and a microprocessor-based "smart" transmitter that is capable of converting and transmitting a signal from the flow tube. Magnetic flow meters shall utilize the characterized field principle of electromagnetic induction, and shall produce DC signals directly proportional to the liquid flow rate.
- B. Each meter shall be furnished with a stainless steel metering tube and carbon steel flanges with a polyurethane liner. Liner shall have a minimum thickness of 0.125 inches. The inside diameter of the liner shall be within 0.125 inches of the inside diameter of the adjoining pipe. Liner protectors shall be provided on all flow tubes.
- C. The flow tube shall be provided with flush mounted electrodes.
- D. Grounding rings shall be provided for all meters.
- E. All materials of construction for metallic wetted parts (electrodes, grounding rings, etc.) shall be minimum Type 316 stainless steel, but shall be compatible with the process fluid for each meter in accordance with the recommendations of the manufacturer.
- F. Flow tube shall be rated for pressures up to 1.1 times the flange rating of adjacent piping. System shall be rated for ambient temperatures of -30 to +65 degrees C. The flow tube and electrical connection shall meet NEMA 6P or IPS68 rating for continuous submergence under 3 meters of water. The transmitter housing shall meet NEMA 4X requirements as a minimum.
- G. The transmitter shall provide pulsed DC coil drive current to the flow tube and shall convert the returning signal to a linear, isolated 4-20 mA DC signal. The transmitter shall utilize "smart" electronics and shall contain automatic, continuous zero correction, signal processing routines for noise rejection, and an integral LCD readout capable of displaying flow rate and totalized flow. The transmitter shall continuously run self-diagnostic routines and report errors via English language messages.
- H. The transmitter's preamplifier input impedance shall be a minimum of 10^9 - 10^{11} ohms which shall make the system suited for the amplification of low-level input signals and capable of operation with a material build up on the electrodes.

- I. The transmitter shall provide an automatic low flow cutoff below a user configurable low flow condition (0-10%). The transmitter's outputs shall also be capable of being forced to zero by an external dry contact operation.
- J. Each flow tube shall be factory calibrated and assigned a calibration constant or factor to be entered into the associated transmitter as part of the meter configuration parameters. Manual calibration of the flow meter shall not be required. Meter configuration parameters shall be stored in non-volatile memory in the transmitter. An output hold feature shall be provided to maintain a constant output during configuration changes.
- K. The transmitter shall be capable of communicating digitally with a remote HART configuration device via a frequency-shift-keyed, high frequency signal superimposed on the 4-20 mA output signal. The remote configuration device shall be capable of being placed anywhere in the 4-20 mA output loop. A password-based security lockout feature shall be provided to prevent unauthorized modification of configuration parameters.
- L. The transmitter shall be equipped with a built-in web server capable of generating a traceable meter verification report in .PDF format that can be downloaded to a PC via Ethernet TCP/IP communications.
- M. Accuracy shall be a minimum of 0.30% of rate over the flow velocity range of 0.3 to 10.0 m/s. Repeatability shall be 0.1% of rate; minimum rangeability shall be 100:1. Minimum required liquid conductivity shall not be greater than 5 uS/cm. Maximum response time shall be adjustable between 1 and 100 seconds as a minimum. Transmitter ambient temperature operating limits shall be -10 to +50 degrees C. Power supply shall be 115 VAC, 60 Hz.
- N. Flow tubes shall be 150-lb flange mounted unless otherwise noted.
- O. The cables for interconnecting the meter and transmitter shall be furnished by the manufacturer. The cable shall be terminated and potted by the manufacturer at the flow tube to prevent moisture intrusion.
- P. Transmitter shall be mounted in the local control panel as indicated on the Electrical Drawings.
- Q. Magnetic flow meter systems shall be Proline Promag W 400 with optional high accuracy calibration and "Heartbeat" Technology option as manufactured by Endress + Hauser or equivalent by Rosemount, ABB, Krohne, Siemens or equal.

PART 3 -- EXECUTION

3.01 REQUIREMENTS

- A. Install flow tubes, cables, and transmitters in strict accordance with the manufacturer's recommendations. Instrumentation subcontractor shall coordinate with Electrical subcontractor to select appropriate cable length. Do not disconnect manufacturer-terminated cables from the flow tube. The cable shall be terminated in the field at the transmitter only, in a manner that will not reduce meter performance and in accordance with manufacture recommendations. Long lengths of coiled cable is not acceptable.
- B. Ground flow tubes and grounding rings in strict accordance with the manufacturer's recommendations.

- END OF SECTION -

SECTION 17749

SUBMERSIBLE LEVEL (PRESSURE) SENSORS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation the submersible level (pressure) sensors, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 - Control and Information System Scope and General Requirements
- B. Section 17700 - Powered Instruments, General

PART 2 -- PRODUCTS

2.01 SUBMERSIBLE LEVEL (PRESSURE) SENSORS

- A. Submersible level (pressure) sensors shall consist of a pressure-sensing probe assembly with a depth cable molded directly to the probe body. Sensing probe housing shall be fabricated of titanium or 316 stainless steel. The depth support cable shall be polyurethane and shall contain a Kevlar strength member, a vent tube, and conductors for electrical power and signal.
- B. The sensor shall contain an encapsulated pressure sensing element which is electrically and physically isolated from the media via a ceramic or titanium isolation diaphragm. The pressure sensing connection shall be protected from damage by a removable acetal nose cone or equivalent guard.
- C. Each submersible level transducer shall be provided with a NEMA 4X termination/junction box and aneroid bellows to prevent moisture from entering the vent tube.
- D. Sensor specifications shall be as follows:
 - 1. Sensor Rating: NEMA 6 (IP68), loop-powered
 - 2. Output Signal: 4-20 mA, 2-wire design
 - 3. Accuracy: $\pm 0.25\%$, F.S. (full scale)
 - 4. Long Term Stability: $\pm 0.1\%$ F.S./year
 - 5. Zero Offset and Span Setting: $\pm 0.25\%$ F.S., max.
 - 6. Operating Temperature: -20 to +60 degrees C
 - 7. Compensated Temperature: -2 to +30 degrees C

- 8. Overpressure Limits: At least 2x full scale range
- 9. Cable Length: As required

- E. Sensor Housing Outer Diameter: Housing outer diameter shall be suitable for installation in the stilling well as detailed on the Drawings.
- F. Submersible level (pressure) sensors shall be WaterPilot Model FMX 167 by Endress & Hauser, equivalent by Druck, KPSI or Devar, or equal.

PART 3 -- EXECUTION

3.01 REQUIREMENTS

- A. Refer to Section 17700, Part 3 of the Specifications.

- END OF SECTION -

SECTION 17760

PRESSURE INDICATING TRANSMITTERS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation the pressure indicating transmitters, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Control and Information System Scope and General Requirements
- B. Section 17700 – Powered Instruments, General

PART 2 -- PRODUCTS

2.01 GAUGE PRESSURE INDICATING TRANSMITTERS

- A. Gauge pressure transmitters shall be of the capacitance type with a process-isolated diaphragm with silicone oil fill, microprocessor-based "smart" electronics, and a field adjustable rangeability of 100:1 input range. Span and zero shall be continuously adjustable externally over the entire range. Span and zero adjustments shall be capable of being disabled internally. Transmitters shall be NEMA 4X weatherproof and corrosion resistant construction with low-copper aluminum body and 316 stainless steel process wetted parts. Accuracy, including nonlinearity, hysteresis and repeatability errors shall be plus or minus 0.065 percent of calibrated span, zero based. The maximum zero elevation and maximum zero suppression shall be adjustable to anywhere within sensor limits. Output shall be linear isolated 4-20 milliamperes 24 VDC. Power supply shall be 24 VDC, two-wire design. Each transmitter shall be furnished with a 4-digit LCD indicator capable of displaying engineering units and/or milliamps and mounting hardware as required. Overload capacity shall be rated at a minimum of 25 MPa. Environmental limits shall be -40 to 85 degrees Celsius at 0-100% relative humidity. Each transmitter shall have a stainless steel tag with calibration data attached to body.
- B. The piezoresistive silicon pressure sensor shall be mechanically, electrically, and thermally isolated from the process and the environment, shall include an integral temperature compensation sensor, and shall provide a digital signal to the transmitter's electronics for further processing. Factory set correction coefficients shall be stored in the sensor's non-volatile memory for correction and linearization of the sensor output in the electronics section. The electronics section shall correct the digital signal from the sensor and convert it into a 4-20 mA analog signal for transmission to receiving devices. The electronics section shall contain configuration parameters and diagnostic data in non-volatile EEPROM memory and shall be capable of communicating, via a digital signal

superimposed on the 4-20 mA output signal, with a remote interface device. Output signal damping shall be provided, with an adjustable time constant of 0-36 seconds. Total long term stability (frequency of calibration) shall be not less than 0.125% for five years.

- C. Where scheduled, gauge pressure indicating transmitters shall be calibrated in feet of liquid for liquid level service.
- D. Gauge pressure indicating transmitters shall be Model 3051T as manufactured by Rosemount, or equal.

2.02 DIFFERENTIAL PRESSURE INDICATING TRANSMITTERS

- A. Differential pressure indicating transmitters shall be the same as the gauge pressure transmitters except for body specifications. Differential pressure units shall be furnished with close coupled stainless steel three valve manifold assembly. Manifold assembly shall be HEX Products Model HM, or equal.
- B. The electronics sections of differential pressure transmitters shall contain user-selectable square root extractors to provide a linear 4-20 mA DC output proportional to flow, when activated. Square root extractor circuitry shall be activated only for incompressible fluid flow applications (i.e., water). Flow rates for compressible fluids (i.e., air) shall be calculated externally using line temperature and static pressure corrections as specified elsewhere in Division 17. In addition, each flow transmitter shall be furnished with laminated flow versus differential pressure curves wall mounted adjacent to the transmitter.
- C. Differential pressure indicating transmitters shall be Model 3051C as manufactured by Rosemount, or equal.

2.03 FLANGE MOUNTED LEVEL INDICATING TRANSMITTERS

- A. Flange-mounted tank liquid level indicating transmitters shall be the same as gauge pressure transmitters except for body type.
- B. The flange-mounted sensor shall consist of a special non-corrosive isolating diaphragm with fill fluid in a sealed capillary system to transmit liquid pressure to the sensing element. A second isolating diaphragm shall transmit pressure through the fill fluid to the sensing diaphragm in the center of the capacitance cell. An isolating diaphragm and fluid fill shall also be provided on the opposite side of the sensing diaphragm to convey atmospheric or reference pressure.
- C. All mounting flanges, diaphragms, O-rings and materials used in construction shall be non-corroding, compatible with each other, and compatible with the liquid being measured.
- D. Flange-mounted liquid level transmitters shall be as manufactured by Rosemount, Model 3051L.

PART 3 -- EXECUTION

3.01 REQUIREMENTS

- A. Refer to Section 17700, Part 3 of the Specifications.

- END OF SECTION -

SECTION 17910 - INSTRUMENT SCHEDULE

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation all instrumentation as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Control System Input/Output Schedule
B. Functional Control Descriptions

PART 2 -- INSTRUMENT SCHEDULE

Pressure Gauges - Section 17650			
Tag Number	Service Description	Range	Remarks
PI-0109A	Raw Water Well PW-9 Discharge (upstream of check valve)	0-160 psi	Provide diaphragm seal
PI-0109B	Raw Water Well PW-9 Discharge (downstream of check valve)	0-160 psi	Provide diaphragm seal
Pressure Switches - Section 17675			
Tag Number	Service Description	Range/Setpoint	Remarks
PSH-0109	Raw Water Well PW-9 Discharge	0-160 psi / 115 psi	Provide diaphragm seal
Magnetic Flow Meters - Section 17701			
Tag Number	Service Description	Range	Remarks
FE/FIT-0109	Raw Water Well PW-9 Flow	0-4 mgd	10" flow tube
Submersible Level Transmitters - Section 17749			
Tag Number	Service Description	Range	Remarks
LT-0109	Raw Water Well PW-9 Water Level	-48.0 to +5.0 Elevation	
Pressure Transmitter - Section 17760			
Tag Number	Service Description	Range	Remarks
PIT-0109	Raw Water Well PW-9 Discharge	0-160 psi	Provide diaphragm seal

- END OF SECTION -

SECTION 17920 - CONTROL SYSTEM INPUT/OUTPUT SCHEDULES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place into satisfactory operation all control system inputs and outputs as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Schedules and Control Descriptions
B. Functional Control Descriptions

PART 2 – RTU-0109 INPUT / OUTPUT SCHEDULE

I.D. NUMBER	SERVICE DESCRIPTION	FUNCTION	TYPE	DRAWING NO.
LI-0109	Raw Water Well PW-9	Level	AI	I-03
YCR-0109	Raw Water Well PW-9 Pump	Start/Stop	DO	I-03
HSX-0109	Raw Water Well PW-9 Pump	Reset Command	DO	I-03
YA-0109	Raw Water Well PW-9 Pump	SSRVS Fault	DI	I-03
IAH-0109	Raw Water Well PW-9 Pump	Overload	DI	I-03
HLX-0109	Raw Water Well PW-9 Pump	Reset Indication	DI	I-03
PAH-0109	Raw Water Well PW-9 Pump Discharge	High Pressure	DI	I-03
YLR-0109	Raw Water Well PW-9 Pump	Running Indication	DI	I-03
YL-0109	Raw Water Well PW-9 Pump	In Remote	DI	I-03
HLR-0109	Raw Water Well PW-9 Pump	In Hand	DI	I-03
HLB-0109	Raw Water Well PW-9 Pump	SSRVS Bypass	DI	I-03
PI-0109	Raw Water Well PW-9 Pump Discharge	Pressure	AI	I-03
II-0109	Raw Water Well PW-9 Pump Motor	Current	AI	I-03
ZAO-0109	Raw Water Well PW-9	Panel Intrusion	DI	i-03
FI-0109	Raw Water Well PW-9	Flow Rate	AI	I-03

PART 3 -- EXECUTION

3.01 INPUT/OUTPUT TYPES

- A. Signals transmitted or received via RTU input/output cards are as follows:
DO – Discrete Output
DI – Discrete Input
AO – Analog Output
AI – Analog Input
- B. Signals transmitted or received via RTU communication ports are as follows:

DODL – Discrete Output Data Link

DIDL – Discrete Input Data Link

AODL – Analog Output Data Link

AIDL – Analog Input Data Link

- C. All RTU data shall be made available to the HMI via its data link using identical tag names and numbers to facilitate consistency between the RTU and HMI databases.
- D. Refer to Drawings and RTU specifications further description of input/output and HMI control interface requirements.

- END OF SECTION -

**City of Hallandale Beach
Production Well PW-9**

**Attachment A
Geotechnical Report**

The attached report is provided for informational purposes with the Contract Documents. The attached report is not a part of the Contract Documents. The City of Hallandale Beach and Hazen and Sawyer make no guarantee, either expressed or implied, as to its accuracy or completeness.



Miami Office

GEOTECHNICAL ENGINEERING | FOUNDATION ENGINEERING | GEOTECHNICAL TESTING | SOIL BORINGS/MONITORING WELLS | CONSTRUCTION MATERIALS TESTING

December 8, 2015

Mr. George Brown, P.E.
Senior Associate
Hazen & Sawyer
4000 Hollywood Boulevard
750N, North Tower
Hollywood, Florida 33021

Re: Report of Subsurface Exploration & Geotechnical Engineering Study
Proposed Water Supply Well No. 9
Near 430 Ansin Boulevard
Hallandale Beach, Florida
NV5 Project No. 14950

Dear Mr. Brown:

NV5, Inc. submits this report in fulfillment of the scope of services described in our contract dated October 26, 2015. This report describes our understanding of the project, presents our evaluations, and provides our professional opinions and recommendations for foundation design and construction for the project.

Sincerely,

NV5, INC.

Richard Fesdjian, P.E.
Project Engineer
Florida License No. 79312



Garfield L. Wray, P.E., D.GE.
Director of Geotechnical Engineering
Florida License No. 49734

Distribution: 2 Copies to Addressee via U.S. Mail
1 Copy to Addressee via Email
1 Copy to NV5 File

f:\doc\nv5 reports\14950-geo rpt- proposed water supply well no. 9 - hazen and sawyer - 430 ansin boulevard, hallandale beach - shallow geo 12-08-15.doc

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CONSTRUCTION QUALITY ASSURANCE • INFRASTRUCTURE ENGINEERING • ENERGY SERVICES • PROGRAM MANAGEMENT • ENVIRONMENTAL SERVICES

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FIGURES

- Drawing 1 Site Vicinity Map & Test Location Plan
Drawing 2 Generalized Subsurface Profile

APPENDIX

- Appendix A – Boring Logs (A-1 through A-4)

1.0 SITE AND PROJECT INFORMATION

Based on information received from you, we understand that the project is located on the west side of the street near 430 Ansin Boulevard in Hallandale Beach, Florida. The project area is bounded by Ansin Boulevard to the east, Interstate I-95 to the west, and swale areas to the north and south. A site vicinity map is presented on Drawing 1. A site survey was not provided to us at the time, however we estimate site grades are around +6 feet with respect to the 1929 National Geodetic Vertical Datum (NGVD).

The proposed water supply Well PW-9 will consist of a 13- by 40-foot slab elevated about 2 feet above the existing grade in the swale area. The slab will be supported on a strip footing. We understand that the uniform foundation bearing pressure will not exceed 600 pounds per square foot (psf) and wall loads will be around 600 pounds per lineal foot (plf).

2.0 PURPOSE AND SCOPE OF WORK

The purpose of our services on this project is to explore the subsurface conditions in order to provide recommendations for foundation design and construction. Specifically this report provides:

- ◆ Drawings showing boring locations, a graphic summary of the generalized subsurface conditions, and boring logs with detailed descriptions of the materials encountered.
- ◆ Discussion of generalized subsurface conditions at the site including groundwater levels.
- ◆ Discussion of feasible foundation type(s) for the proposed construction.
- ◆ Design parameters for the recommended foundation types, including vertical and lateral load resistance.
- ◆ Estimates of foundation settlements.
- ◆ Recommendations for site preparation and grading, including the re-use of site-excavated materials for fill, fill placement and compaction, and slab subgrade preparation.
- ◆ Construction considerations including excavation support and dewatering, impacts of existing foundations, and impacts for adjacent structures.

3.0 FIELD EXPLORATION

We performed an exploration of the subsurface conditions with two (2) engineering test borings drilled to 30 feet below existing grade within the proposed well footprint at the approximate locations shown on Drawing 1. The test locations were marked and identified in the field by NV5. The borings were drilled with a truck-mounted drill rig utilizing the rotary wash method. Samples of the subsurface materials

were recovered at roughly 2-foot intervals within the upper 10 feet of the borings and at approximately 5-foot intervals thereafter using a Standard Penetration Test split-spoon sampler (SPT) in substantial accordance with ASTM D-1586, "Standard Test Method for Standard Penetration Test and Split-Barrel Sampling of Soils." This test procedure drives a 1.4-inch I.D. split-tube sampler into the subsurface profile using a 140-pound hammer falling 30 inches. The total number of blows required to drive the sampler the second and third six-inch increments is the SPT N-value, in blows per foot, and is an indication of material strength. Upon completion of the borings, the boreholes were backfilled to the ground surface with soil cuttings and grouted at the top foot from the surface.

The soil/rock samples recovered from the borings were classified by a geotechnical engineer. The collected samples were later re-examined to confirm field classifications. Visual soil classifications were made in accordance with ASTM D2487 and ASTM D2488. The results of the classification and consequent generalized stratification are shown in Drawing 2, the generalized subsurface profile, and in the records of test borings in Appendix A (sheets A-1 through A-4). Strata contacts shown on these drawings are approximate. The boring data reflect conditions at the specific test locations only, and at the time the borings were drilled.

4.0 LOCAL GEOLOGY AND GEOLOGIC HAZARDS

4.1 LOCAL GEOLOGY

Broward County is located on the southern flank of a stable carbonate platform on which thick deposits of limestones, dolomites and evaporites have accumulated. The upper two hundred feet of the subsurface profile is composed predominantly of limestone and quartz sand. These sediments were deposited during several glacial and interglacial stages when the ocean was at elevations higher than present.

In many portions of Broward County, surface sand deposits of the Pamlico Formation are encountered. The Pamlico sands overlie the Miami Limestone. In western Broward County, portions of the Everglades Region interfinger with the Pamlico sand. The Everglades soil consists of peat and calcareous silt (marl).

The Miami Limestone is a soft to moderately hard, white, porous to very porous, sometimes sandy, oolitic calcareous cemented grainstone. The formation outcrops in portions of Broward County. The Miami Limestone has a maximum thickness of about 35 feet along the Atlantic Coastal Ridge and thins sharply near the coastline and more gradually in a westerly direction. The Miami Limestone was formed about 130,000 years ago at a time when the sea level was twenty-five feet higher than it is today. This environment facilitated formation of concentrically layered sand sized carbonate grains called oolites. These grains formed by repeated precipitation of calcium carbonate around the nucleus of a sand or shell grain.

The Miami Limestone can be separated into two facies: the barrier bar oolitic facies and the tidal shoal limestone facies. The barrier bar facies is characterized by lenses of oolitic limestone separated by intermittent, 1-inch thick or less, uncemented sand layers (cross-bedded limestone). Zones of higher porosity are characteristic and parallel the bedding planes of the cross-bedded limestone. The tidal shoal limestone facies is characterized by a distinct lack of bedding planes. In addition, burrowing organisms have churned previously deposited sediments, which have resulted in high porosity channels in the rock. These ancient channels give the rock an appearance of a hardened sponge in some areas.

The Fort Thompson Formation underlies the Miami Limestone, and includes sand, sandstone, and limestone. The upper zones of the Fort Thompson Formation consist of sand having a thickness ranging from 5 to 35 feet. The remainder of the formation consists of coralline limestone, quartz sandstone, sandy limestone and freshwater limestone. The type of soils within the formation and the degree of cementation vary with lateral extent and depth.

The Fort Thompson Formation is underlain by the Tamiami Formation. The Tamiami Formation consists of sands, silts, clays, and sometime fossiliferous limestone. The upper portions of the Tamiami Formation are permeable and make up the lower reaches of the Biscayne Aquifer. This formation ranges in thickness from zero to 300 feet in South Florida.

4.2 GEOLOGIC HAZARDS

The South Florida area is relatively free of geologic hazards. The region is not considered seismically active. Consequently hazards such as ground shaking, liquefaction, lateral spreading, and ground rupture that are normally associated with earthquakes and other seismic activity are generally not a factor for the design of structure foundations in South Florida. Based on the 2012 International Building Code, a Site Class D classification is considered appropriate for this site.

Karst topography that is associated with the formation of sinkholes and other underground discontinuities in carbonate rock formations in the central and northern portions of Florida is generally not found in South Florida. Any discontinuities in the limestone due to solutioning of the rock are typically very limited in vertical and lateral extent and are usually not considered a factor in the design of foundations in the local practice.

5.0 SUBSURFACE CONDITIONS

In general, the subsurface conditions encountered in the borings are generally consistent with the geology described above. The detailed subsurface conditions are presented graphically in the attached generalized subsurface profile (Drawing 2) and in more detail on the records of test boring sheets. The subsurface conditions disclosed

by the borings can be generalized as shown below:

Layer 1 – Surficial Fill and Sand:

This layer consists of sand with limestone fragments (fill) and sand and is about six to eight feet thick in the borings. SPT N-values ranging from 5 to 15 blows per foot (bpf) were recorded in this layer. The average of the recorded SPT N-value is 9 bpf, indicating the layer is typically loose.

Layer 2 –Limestone

Beneath the fill and sand layer is tan limestone that extends to the termination depth of the borings at 30 feet below grade. SPT N-values in the limestone layer range from 8 to greater than 50 bpf, with an average value of at least 39 bpf. The limestone is very soft to soft in the upper 10 to 15 feet, and grades moderately hard to hard below that depth.

Table 1 below summarizes our estimates of engineering parameters considered pertinent to the design of foundations for the proposed additions.

TABLE 1 - SUMMARY OF ESTIMATED PERTINENT ENGINEERING PARAMETERS

Layer ID	Description	Thickness (ft)	SPT N-values		Modulus of Elasticity (ksf)	Unconfined Compressive Strength (ksf)	Allowable Side Shear (ksf)
			Range	Avg			
1	Surficial Fill and Sand	6 – 8	5 – 15	9	350	-	-
2	Limestone	22+	8 – 50+	39	10,000 – 15,000	300 - 500	3 - 5

We note that the values of allowable side shear estimated in Table 1 above are based on our experience and laboratory data from similar soils that we have tested.

Groundwater

Groundwater was encountered in the borings at 3.8 feet below the existing ground surface. This depth corresponds approximately to about Elevation +2.2 feet NGVD. On average, groundwater levels in the general vicinity of the project vary between elevations +0 to +4 feet NGVD, the variations being primarily as a result of tidal fluctuations and seasonal rainfall. Storm and hurricane events and construction activities also result in variations in the groundwater levels. Notwithstanding the variations acknowledged, we anticipate that groundwater at the site will generally be encountered within the upper 5 feet of the existing ground surface.

6.0 EVALUATION AND DISCUSSION

6.1 FOUNDATION SUPPORT

We consider the site suitable for the proposed project from a geotechnical perspective. The primary concerns for foundation design and construction include support of the proposed new structure loads without unacceptable settlement, and minimizing adverse settlement impacts to existing adjacent structures. Based on the subsurface conditions disclosed by the borings, the proposed project components can be supported on shallow foundations after the area has been prepared as recommended herein.

Detailed foundation design and construction recommendations are presented in Section 7 of this report.

6.2 ESTIMATED SETTLEMENT

With an overall base pressure of 0.6 ksf for the proposed additions, we estimate that foundation settlements will be on the order of 1 inch with edge-to-center differential settlements on the order of ½ inch.

The granular nature of the subsurface materials at the site will result in the majority of the structure settlement occurring during construction and for a short time period (typically less than two months) following substantial completion of the construction.

6.3 MISCELLANEOUS ENVIRONMENTAL IMPACTS

Environmental forces consist of sinkholes, freeze thaw damage, shrinking and swelling soils, and hurricane scour can affect the performance of a foundation system. Sinkholes, freeze-thaw, and shrinking/swelling soils are generally not of concern in the South Florida area. While a detailed study of hurricane scour was outside the scope of this study, it is nonetheless our opinion that the foundation systems recommended herein when properly designed and constructed, will resist hurricane scour forces. It is therefore our opinion that these specific environmental forces have a low risk (on a scale of low, moderate, high) of adversely affecting deep foundation performance at this site provided the foundation system is designed and constructed as recommended herein.

7.0 RECOMMENDATIONS

Our recommendations for geotechnical design and construction of the proposed project are provided below in the following sections.

7.1 SITE PREPARATION AND GRADING

1. Geotechnical site preparation for construction should consist of removal of all existing structures, foundations, pavements, underground utilities, and other deleterious materials within proposed additions and pavement footprints plus a five-foot perimeter where possible. Any voids created by the removal of these deleterious materials should be properly backfilled as described in the paragraphs below.

No information has been provided about previous or existing foundations at the site and we are not aware of the site development history beyond its current condition. Where old spread or other foundations are encountered, they should be removed and replaced with compacted fill if they interfere with new foundations or utilities. If the old foundations do not interfere with new construction they could be left in place. Backfilling of old foundation excavations should be performed in accordance with the recommendations provided in this report.

2. After site preparation as described above, areas for structures that will have slabs on grade or pavements should be proof rolled and densified with a 20-ton roller making at least 5 overlapping passes as it operates at its maximum vibrational frequency, and a travel speed of not more than two feet per second. The proof rolling should be observed by NV5 to identify and mitigate any weak subgrade conditions evidenced by yielding or rutting at the wheels of the roller. Proof-rolling should include planned development footprints plus a five-foot perimeter.
3. In general fill soils should consist of either inorganic, non-plastic sand having less than 10 percent material passing the No. 200 sieve, or crushed limestone with a maximum rock size of six (6) inches. In particular, fill soils placed within the upper 12 inches of the subgrade of building slabs on grade should consist of either sand with less than 10 percent passing the number 200 sieve, or crushed limestone with a maximum particle size of three inches.

Based on our boring data the near-surface sandy materials should satisfy the fill criteria, but might require localized sorting and moisture-conditioning prior to re-use. In any event, representative samples of the fill soils should be collected for classification and compaction testing. The maximum dry density, optimum moisture content, gradation, and plasticity should be determined. These tests are needed for quality control of the compacted fill.

4. Fill soils should be placed with loose lift thicknesses of not more than 12-inches, moisture-conditioned to within two (2) percent of the optimum moisture content based on ASTM D-1557, and compacted to a minimum 95 percent relative

compaction¹. One test should be performed for each 2,500 square feet of fill area per lift of fill soils and every 50 linear feet in trenches. Fill particles exceeding one (1) inch in size should not be allowed to nest within the fill.

The vibrations produced by the operation of the compactor should be monitored for potential adverse effect on adjacent existing structures, pavements, and utilities. If nearby structures will be affected by the vibration of the compactor, the compaction procedure may require modification as approved by the geotechnical engineer.

7.2 FOUNDATION SUPPORT

1. After preparing the site as described above the additions may be supported on shallow spread foundations bearing in the sandy material and designed for a maximum allowable bearing pressure of 1,500 psf. The bottoms of footings should be embedded at least 12 inches below lowest adjacent grade.
2. To assure an adequate factor-of-safety against a general shearing failure, strip and continuous footings should be at least 18 inches wide, and isolated footings should be no less than 30 inches wide.
3. Resistance to lateral loads can be provided by passive pressure acting on the vertical faces of the foundation elements, and by friction between the bottom of foundation elements and the supporting subgrade. We recommend using an equivalent fluid weight of 180 pounds per cubic foot (pcf) to compute passive resistance for moist soil above the water table, and 80 pcf to compute passive resistance in submerged soil. Passive resistance in the upper 12 inches of soil should be neglected unless it is confined by a slab or pavement. Frictional resistance may be computed using a factor of 0.30 times the sustained dead loads.

The above values include a factor of safety of at least 1.5. These values of resistance assume that the foundations are: 1) in-situ soil densified by compaction, or clean sand fill which is compacted to 95 percent relative compaction, and 2) able to withstand horizontal movement on the order of ¼ to 3/8 inch.

7.3 GROUND FLOOR SLABS

1. Ground floor slabs can be supported on grade after preparing the site as described above.

¹

Relative compaction refers to the in-place dry unit weight of a material expressed as a percentage of the maximum dry unit weight of the same material as determined in the laboratory using the Modified Proctor procedure (ASTM D1557).

2. For slab design we recommend a modulus of subgrade reaction of 150 pounds per inch (pci).
3. Slabs should be reinforced for the loads that they will sustain and construction joints should be provided at frequent intervals.
4. Slabs in contact with soil are subject to movement of moisture from the soil upward through the slab. To prevent such moisture vapor transmission, a moisture barrier should be placed on the slab subgrade, and should be protected from damage during construction. Construction joints should be provided with water stops in any permanently submerged areas.
5. Slabs should be designed to resist any hydrostatic forces to which they will be subjected.

7.4 EXCAVATION AND DEWATERING

1. Shallow excavations into the near-surface materials will likely stand vertical for short periods of time only. The excavation sides will unravel over time as they are exposed to weather and construction traffic. Weaker sandy zones below the water table could become loose if unsupported. Deeper excavations that will remain open for longer periods of time will require support in the form of temporary shoring or sliding trench boxes to prevent instability of excavation walls and to protect workers from injury. All excavations should comply with Occupational Safety and Health Administration (OSHA) design and safety requirements. Shoring designs should be signed and sealed by a Florida-licensed professional engineer, and should be provided for the Owner's review.
2. Particular attention should be paid to any excavations and the potential impacts these could have on existing foundations.
3. Average groundwater elevation is expected to be approximately between Elevation +0 and +4 feet NGVD for this site. In general footing excavations are not expected to encounter water. Nonetheless, some dewatering could be required for the installation of deeper utilities. We judge that localized dewatering of foundation excavations can be accomplished using pumps and sumps. Dewatering of larger excavations and larger volumes will require the installation of well points or other dewatering systems.

It should be noted there are two components to the dewatering process. The first is extracting the water from the subsurface and the requirement of the project to maintain a dry excavation to allow construction to proceed. The other component is the ability to discharge the volume of water extracted. The contractor must ensure this capability exists for the site such that all dewatering and consequent effluent discharge will meet the requirements of the local jurisdictional agencies including Miami-Dade County, Florida Department of

Environmental Protection (FDEP), Florida Department of Transportation, and South Florida Water Management District (SFWMD) as appropriate. This study did not include specific testing or analysis to determine if dewatering is feasible or if adequate discharge is available.

During dewatering the adjacent properties must be monitored for adverse impacts from dewatering drawdown.

The dewatering subcontractor should submit a proposed design for dewatering operations to the owner for review and approval prior to commencing work.

7.5 OTHER RECOMMENDATIONS

1. NV5 should participate in the design development phases of this project in order to modify the recommendations provided above as changes occur during the design development process.
2. NV5 should participate in the geotechnical aspects of construction to 1) verify that the subsurface conditions encountered are consistent with those described in our reports, and address needed changes to the foundation recommendations if site conditions different from those described herein are encountered, 2) evaluate field problems as they arise and recommend solutions, and 3) observe and test the foundation installation to satisfy the requirements of the Florida Building Code and municipal agencies.

8.0 REPORT LIMITATIONS

This report has been prepared for the exclusive use of the Owner and other members of the design/construction team for the specific projects discussed in this report. This report has been prepared in accordance with generally accepted local geotechnical engineering practices; no other warranty is expressed or implied.

The evaluation and recommendations submitted in this report are based in part upon the data collected from the field exploration. The nature or extent of variations throughout the subsurface profile may not become evident until the time of construction. If variations then appear evident, it may be necessary to evaluate our recommendations as provided in this report. In the event changes are made in the nature, design or locations of the proposed project construction, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions modified or verified in writing by NV5.

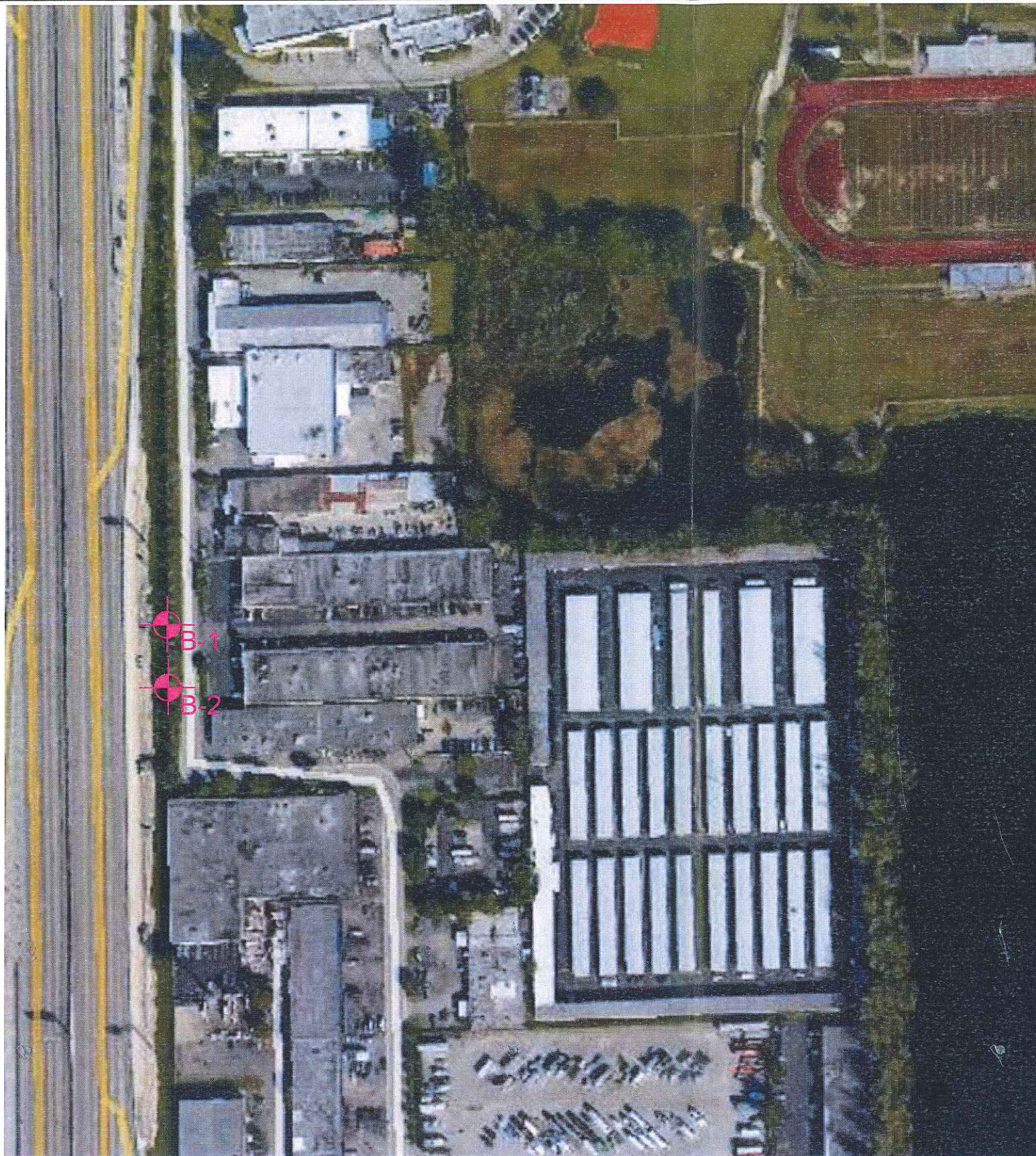
The scope of services did not include any environmental assessment or investigation for the presence or absence of wetlands, sinkholes, chemically hazardous or toxic materials in the soil, surface water, groundwater or air, on or below or around the site.

We should be provided the opportunity to review final foundation specifications and review foundation design drawings, in order to ascertain whether our recommendations have been properly interpreted and implemented. If NV5. is not afforded the opportunity to participate in construction related aspects of foundation installation as recommended in this report, we can accept no responsibility for the interpretation of our recommendations made in this report or for foundation performance.

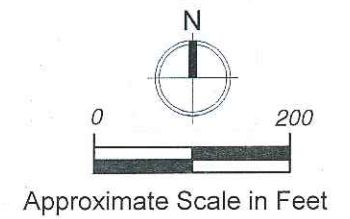
9.0 CLOSURE

We appreciate the opportunity to provide specialized engineering services on this project and look forward to an opportunity to participate in construction related aspects of the development. If you have questions about information contained in this report contact the writer at 305.901-1921.

DRAWINGS



Site Vicinity Map



LEGEND:

 - Soil Boring Test Location

NOTES:

1. Test locations shown are approximate.
2. Test location symbols are not to scale.
3. Base for this drawing taken from Google Earth, 2015.

NV5

DRAWING TITLE: Site Vicinity Map & Test Location Plan

PROJECT NAME: Proposed Water Supply Well No. 9

PROJECT LOCATION: 430 Ansin Boulevard, Hallandale Beach, Florida

PROJECT NO: 14950

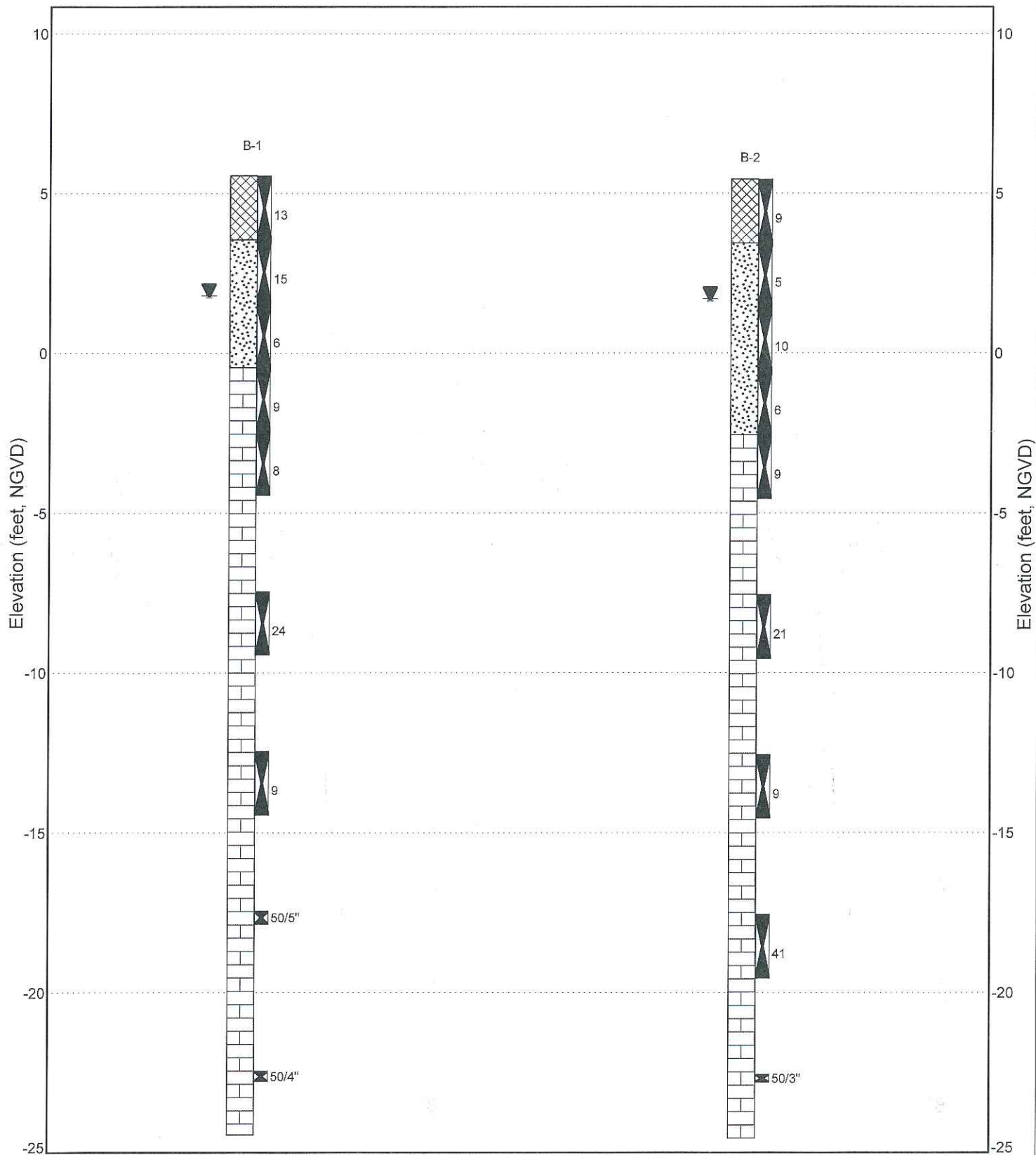
DATE: 12/07/15

DWG NO: 1

DWN BY: AS

CKD BY: GLW

APD BY: —



GENERALIZED SUBSURFACE PROFILE

N|V|5

PROJECT NAME: Proposed Water Supply Well No. 9

PROJECT LOCATION: 430 Ansin Boulevard, Hallandale Beach, Florida

PROJECT NUMBER: 14950

DATE: 12/07/15

DRAWN BY: AS

CHECKED BY: GLW

DRAWING NO: 2

LEGEND



Fill (made ground)



Poorly-graded Sand



Limestone



Standard Penetration Test



Water Level

APPENDIX A

BORING LOG DATA

PROJECT NAME Proposed Water Supply Well No. 9

PROJECT NUMBER 14950

PROJECT LOCATION 430 Ansin Boulevard, Hallandale Beach, Florida

DATE STARTED 11/5/15

COMPLETED 11/5/15

GROUND ELEVATION 5.5 ft

HOLE SIZE 3 inches

DRILLING CONTRACTOR NV5



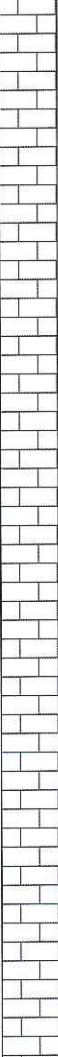
▼ GROUND WATER LEVELS: 3.8 ft / Elev 1.8 ft

DRILLING METHOD Rotary drill with mud, wash & casing

LOGGED BY R. Jimenez

CHECKED BY A. Sarsour

NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (ft., NGVD)
0						5
	SPT	2-7-6-3 (13)	FILL		SAND, medium dense, dark gray sand with roots and 4" of top soil (Possible Fill)	3.5
	SPT	3-4-11-9 (15)	SP		▼ SAND, medium dense, dark to light gray	
5	SPT	3-3-3-3 (6)			SAND, loose, brown	0
	SPT	3-2-7-13 (9)	LS		LIMESTONE, very soft, light brown	-0.5
	SPT	7-6-2-1 (8)			LIMESTONE, very soft, light brown with sand	
10						-5
	SPT	9-11-13-11 (24)			LIMESTONE, soft, tan	-10
15						
	SPT	9-5-4-5 (9)			LIMESTONE, very soft, tan	-15
20						
	SPT	50/5" (100)			LIMESTONE, hard, gray with sand	-20
25						
	SPT	50/4" (100)			LIMESTONE, hard, tan	-24.5
30						

Boring terminated at 30.0 feet.

PROJECT NAME Proposed Water Supply Well No. 9

PROJECT NUMBER 14950

PROJECT LOCATION 430 Ansin Boulevard, Hallandale Beach, Florida

DATE STARTED 11/5/15

COMPLETED 11/5/15

GROUND ELEVATION 5.5 ft

HOLE SIZE 3 inches

DRILLING CONTRACTOR NV5



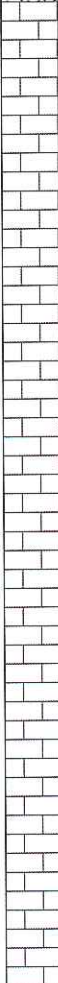
▼ GROUND WATER LEVELS: 3.8 ft / Elev 1.8 ft

DRILLING METHOD Rotary drill with mud, wash & casing

LOGGED BY R. Jimenez

CHECKED BY A. Sarsour

NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (ft., NGVD)
0						5
	SPT	2-4-5-5 (9)	FILL		SAND, loose, dark brown sand with roots, top soil and limestone fragments (Possible Fill)	3.5
	SPT	2-2-3-1 (5)	SP		▼ SAND, loose, dark gray with peat and a trace of silt	
5	SPT	2-5-5-2 (10)			SAND, loose, gray	0
	SPT	3-4-2-1 (6)			SAND, loose, gray	-2.5
	SPT	1-3-6-7 (9)			LIMESTONE, very soft, tan	-5
10			LS			
	SPT	8-9-12-11 (21)			LIMESTONE, soft, tan	-10
15						
	SPT	7-5-4-6 (9)			LIMESTONE, very soft, tan	-15
20						
	SPT	49-16-25-23 (41)			LIMESTONE, medium hard, tan with sand	-20
25						
	SPT	50/3" (100)			LIMESTONE, hard, tan	-24.5
30						-24.5

Boring terminated at 30.0 feet.

KEY TO SYMBOLS

Symbol Description

Strata symbols



Fill



Concrete



Silty sand



Asphalt



Limestone



Sandstone



Sand



Gravel



Peat

Misc. Symbols



Groundwater level measured at boring completion. The date checked is indicated.



Boring continues



End of Boring

Soil Samplers



Standard penetration test.
140 lb. hammer dropped 30"



Hand Auger



Rock Core

Notes:

1. Exploratory borings were drilled on 11/05/2015 using a 3-inch diameter rotary drill with mud, wash & casing.
2. Groundwater was encountered at a depth of 3.8 feet below grade upon boring completion.
3. Boring locations were taped from existing features.
4. These logs are subject to the limitations, conclusions, and recommendations in this report.
5. Results of tests conducted on samples recovered are reported on the logs.

NOTES RELATED TO RECORDS OF TEST BORING AND GENERALIZED SUBSURFACE PROFILE

1. Groundwater level was encountered and recorded (if shown) following the completion of the soil test boring on the date indicated. Fluctuations in groundwater levels are common; consult report text for a discussion.
2. The boring location was identified in the field by offsetting from existing reference marks and using a cloth tape and survey wheel.
3. The borehole was backfilled to site grade following boring completion, and patched with asphalt cold patch mix when pavement was encountered.
4. The Record of Test Boring represents our interpretation of field conditions based on engineering examination of the soil samples.
5. The Record of Test Boring is subject to the limitations, conclusions and recommendations presented in the report text.
6. "Field Test Data" shown on the Record of Test Boring indicated as 11/6 refers to the Standard Penetration Test (SPT) and means 11 hammer blows drove the sampler 6 inches. SPT uses a 140-pound hammer falling 30 inches.
7. The N-value from the SPT is the sum of the hammer blows required to drive the sampler the second and third 6-inch increments.
8. The soil/rock strata interfaces shown on the Record of Test Boring are approximate and may vary from those shown. The soil/rock conditions shown on the Record of Test Boring refer to conditions at the specific location tested; soil/rock conditions may vary between test locations.
9. Relative density for sands/gravels and consistency for silts/clays and limestone are described as follows:

SPT Blows/ Foot	Sands/Gravels Relative Density	SPT Blows/Foot	Silt/Clay Relative Consistency	SPT Blows/ Foot	Limestone Relative Consistency
0-4	Very loose	0-2	Very Soft	0-20	Very Soft
5-10	Loose	3-4	Soft	21-30	Soft
11-30	Medium Dense	5-8	Firm	31-45	Medium Hard
31-50	Dense	9-15	Stiff	46-60	Moderately Hard
Over 50	Very Dense	16-30	Very Stiff	61-50/2"	Hard
		Over 30	Hard	Over 50/2"	Very Hard

10. Grain size descriptions are as follows:

<u>NAME</u>	<u>SIZE LIMITS</u>
Boulder	12 inches or more
Cobbles	3 to 12 inches
Coarse Gravel	3/4 to 3 inches
Fine Gravel	No. 4 sieve to 3/4 inch
Coarse Sand	No. 10 to No. 4 sieve
Medium Sand	No. 40 to No. 10 sieve
Fine Sand	No. 200 to No. 40 sieve
Fines	Smaller than No. 200 sieve

11. Definitions related to adjectives used in soil/rock descriptions:

<u>PROPORTION</u>	<u>ADJECTIVE</u>	<u>APPROXIMATE ROOT DIAMETER</u>	<u>ADJECTIVE</u>
About 10%	with a trace	Less than 1/32"	Fine roots
About 25%	with some	1/32" to 1/4"	Small roots
About 50%	and	1/4" to 1"	Medium roots
		Greater than 1"	Large roots

**City of Hallandale Beach
Production Well PW-9**

**Attachment B
FDOT Pump Station Record Drawings
(West Side of I-95 South of Pembroke Road)**

These record drawings are provided for informational purposes with the Contract Documents. The City of Hallandale Beach and Hazen and Sawyer make no guarantee, either expressed or implied, as to its accuracy or completeness.

SOUTH FLORIDA WATER
MANAGEMENT DISTRICT

CONSTRUCTION
COMPLETION / CERTIFICATION
MAPS

PERMIT NUMBER:

06-02942-P

APPLICATION #

010601-42

ISSUED DATE:

Feb. 17, 2004

INDEX OF PLANS		STATE OF FLORIDA	
SHEET NO. 10		DEPARTMENT OF TRANSPORTATION	
SHEET DESCRIPTION		I-95 PUMP STATION	
C-1	BY PUMP PLAN	BROWARD COUNTY	
C-2	BY PUMP PLAN	STORMWATER IMPROVEMENT PROJECT	
C-3	BY PUMP PLAN	FINANCIAL PROJECT ID: 409733 1 52 01	
C-4	BY PUMP PLAN		
C-5	BY PUMP PLAN		
C-6	BY PUMP PLAN		
C-7	BY PUMP PLAN		
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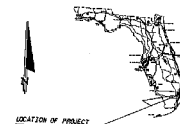
INDEX NO.

5-48
0-48

DEPARTMENT OF TRANSPORTATION

STORMWATER IMPROVEMENT PROJECT
FINANCIAL PROJECT ID: 409733 1 52 01

LOCATION OF PROJECT



84" PIPE LINE
SUBMITTAL No. 011R2

JANUARY 2002

REV SHEET REVISIONS		
DATE	BY	DESCRIPTION
1/22/00	MAC	REVISIONS AS PER GAS COMMENTS



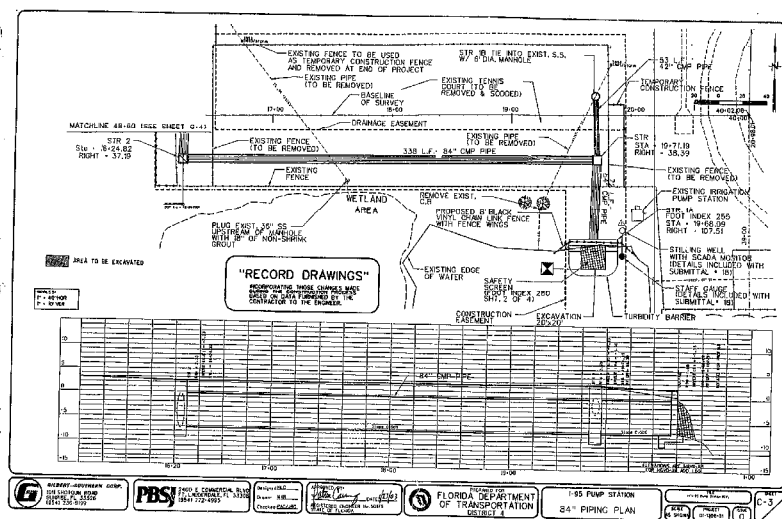
GILBERT SOUTHERN CORP
1011 SHOTGUN ROAD
SURFIDE, FL 33326
(954) 236-0189

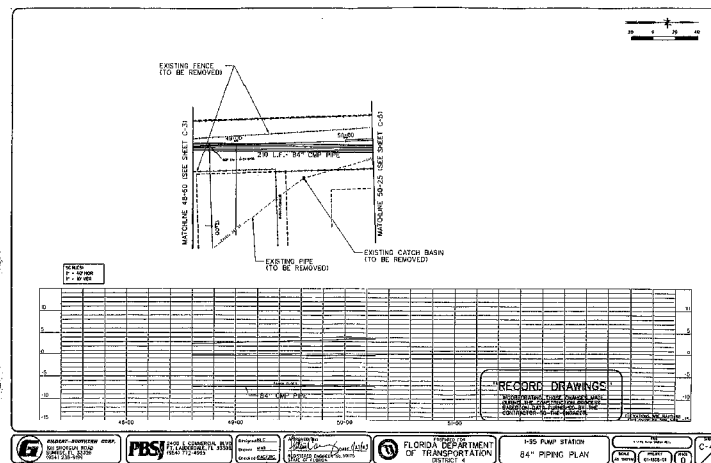
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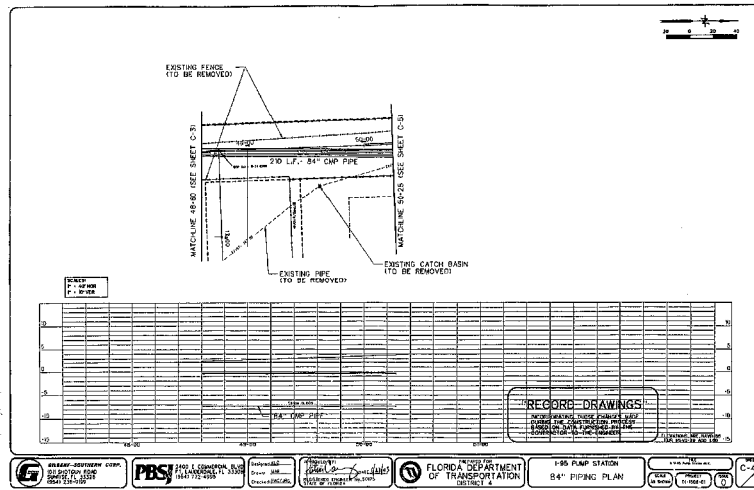
INCORPORATING THOSE CHANGES MADE DURING THE CONSTRUCTION PROCESS BASED ON DATA FURNISHED BY THE CONTRACTOR TO THE ENGINEER

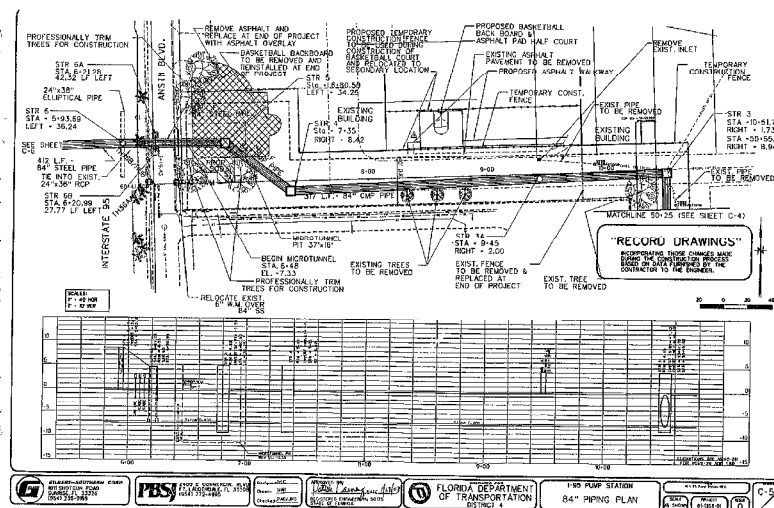
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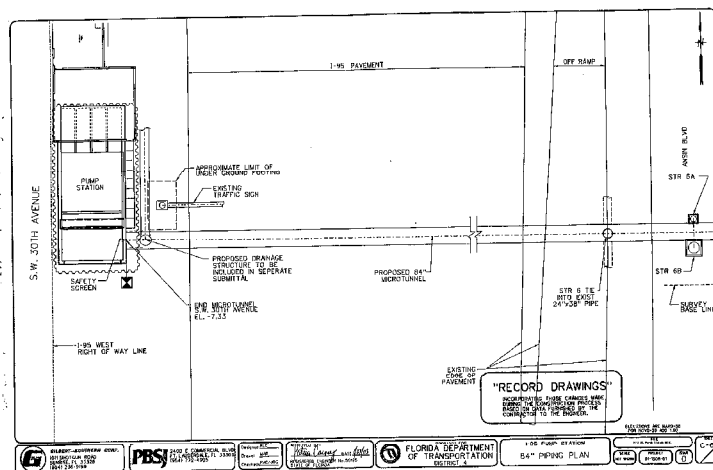
John L. Campbell, Jr., Editor
Florida Heritage, P.O. Box 1600
Tallahassee, Florida 32301

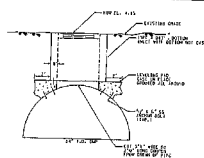




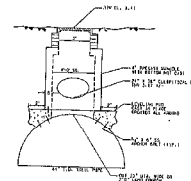








PRECAST "DOGHOUSE" DETAIL STR. 5A
NOT TO SCALE



PRECAST "DOGHOUSE" DETAIL STR. 6
NOT TO SCALE

STATION	TYPE	DESCRIPTION	REMARKS	REVISION
1	10-10	REINFORCING BARS FOR NEW CONCRETE	10-10	1
2	10-10	REINFORCING BARS FOR NEW CONCRETE	10-10	2
3	10-10	REINFORCING BARS FOR NEW CONCRETE	10-10	3
4	10-10	REINFORCING BARS FOR NEW CONCRETE	10-10	4
5	10-10	REINFORCING BARS FOR NEW CONCRETE	10-10	5
6	10-10	REINFORCING BARS FOR NEW CONCRETE	10-10	6
7	10-10	REINFORCING BARS FOR NEW CONCRETE	10-10	7
8	10-10	REINFORCING BARS FOR NEW CONCRETE	10-10	8
9	10-10	REINFORCING BARS FOR NEW CONCRETE	10-10	9
10	10-10	REINFORCING BARS FOR NEW CONCRETE	10-10	10

"RECORD DRAWINGS"
RECORDING THESE DRAWINGS HAVE
BEEN MADE BY THE
CONSULTING ENGINEER AT THE
REQUEST OF THE BUREAU.

FLORIDA DEPARTMENT OF TRANSPORTATION

1-88 PUMP STATION
2-1-10
STANDARD STRUCTURES
SECTION 10-10

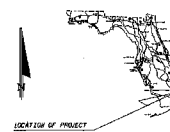
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S-1	GENERAL STRUCTURAL NOTES
S-2	STRUCTURAL SLAB PLAN
S-3	STRUCTURAL SLAB PLAN
S-4	STRUCTURAL ROOF PLAN
S-5	STRUCTURAL DETAILS
S-6	STRUCTURAL DETAILS
S-7	STRUCTURAL DETAILS
S-8	STRUCTURAL DETAILS
S-9	STRUCTURAL DETAILS
S-10	STRUCTURAL PLAN/SECTION
S-11	STRUCTURAL SECTION/DETAIL
S-12	STRUCTURAL SECTION/DETAIL
S-13	STRUCTURAL DETAILS
S-14	TYPICAL CONNECTION DETAILS
S-15	TYPICAL DETAILS

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

I-95 PUMP STATION
BROWARD COUNTY
STORMWATER IMPROVEMENT PROJECT
FINANCIAL PROJECT ID: 409733 1 52 01



LOCATION OF PROJECT _____



PUMP STATION
STRUCTURAL-SUBSTRUCTURE PACKAGE
SUBMITTAL No.012 R1

JANUARY 2002

PLAN SHEET POSITION

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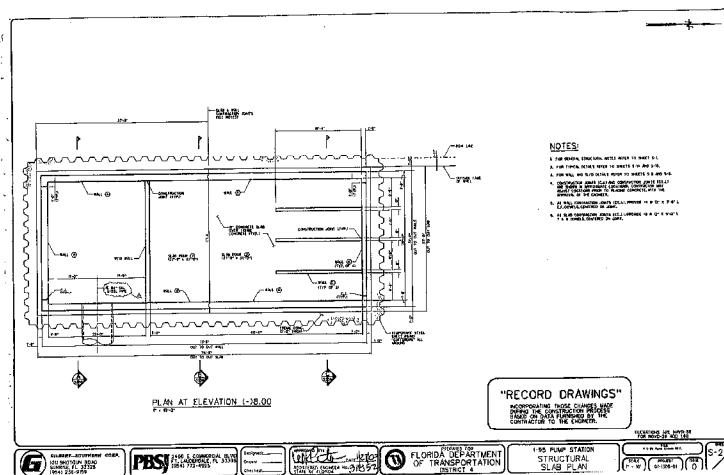
GILBERTSOUTHERN CORP.
1011 SHOFGIN ROAD
SUNRISE, FL 33526
(954) 236-9199

"RECORD DRAWINGS"

INCORPORATING THOSE CHANGES MADE
DURING THE CONSTRUCTION PROCESS
BASED ON DATA FURNISHED BY THE
CONTRACTOR TO THE ENGINEER.

PBSJ

3730 W. COMMERCIAL BOULEVARD
SUITE 200
FT. LAUDERDALE, FL. 33309
954/773-7011



NOTES

1. FOR GENERAL STRUCTURE, REFER TO SHEET 5-1.
2. FOR TYPES, DETAILS, REFER TO SHEETS 5-2 AND 5-3.
3. FOR WALL AND SLAB DETAILS, REFER TO SHEETS 5-4 AND 5-5.
4. CONSTRUCTION SHALL BE IN ACCORDANCE WITH THE 1991 IBC AND THE 2003 IBC. ALL MATERIALS SHALL BE OF THE QUALITY SPECIFIED IN THE SCHEDULE OF MATERIALS, WITH THE APPROVAL OF THE ENGINEER.
5. ALL WALL, CONSTRUCTION SHALL BE IN ACCORDANCE WITH THE 1991 IBC AND THE 2003 IBC. ALL MATERIALS SHALL BE OF THE QUALITY SPECIFIED IN THE SCHEDULE OF MATERIALS, WITH THE APPROVAL OF THE ENGINEER.

"RECORD DRAWINGS"

INCORPORATING THOSE CHANGES MADE DURING THE CONSTRUCTION PROCESS BASED ON DATA FURNISHED BY THE CONTRACTOR TO THE ENGINEER.

QUESTIONS: LIFE, MATH, & SCIENCE

G GILBERT-ATWOOD CO.
101 SHOTGUN ROAD
GUNN, FL 32325
(904) 238-9779

PBS 3460 E. COMMERCIAL BL.
FT. LAUDERDALE, FL 33308
(305) 772-4925

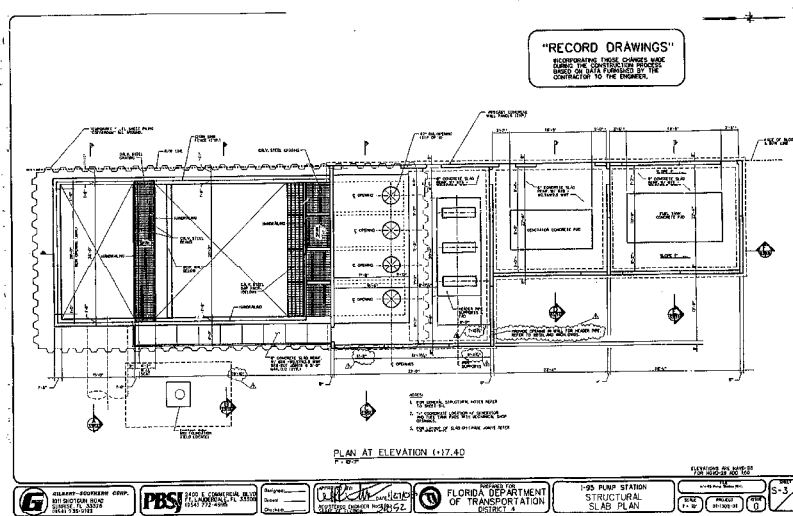
NOTARIES PUBLIC
STATE OF FLORIDA
My Comm. Expires 12/10/07
31852

FLORIDA DEPARTMENT
OF TRANSPORTATION
DISTRICT 4

1-95 PUMP STATION
STRUCTURAL
SLAB PLAN

DATE (mm - dd - yy) 01-13-05-04

0 S-2



ALLIANT-ROCKWELL CORP.
 801 SOUTH BAY
 SUITE 100
 MIAMI, FL 33130

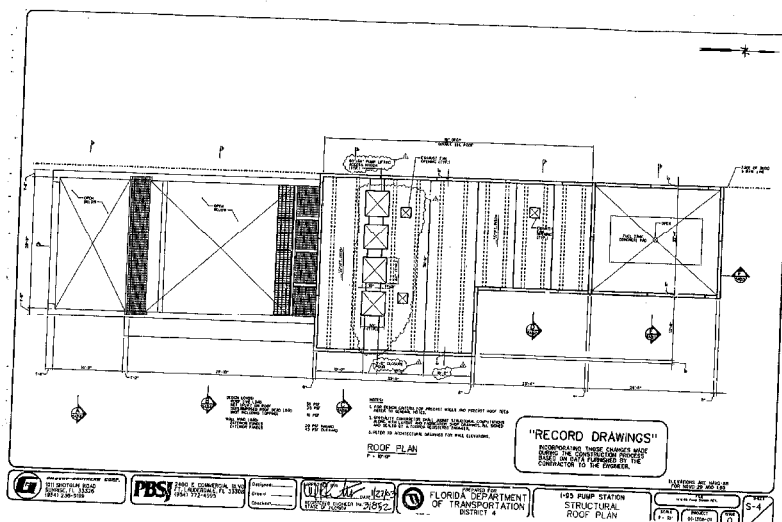
PBS
 2101 E. UNIVERSITY AVE.
 SUITE 100
 MIAMI, FL 33136

DESIGNED BY
 DATE: _____
 CHECKED BY
 DATE: _____

APPROVED BY
 FLORIDA DEPARTMENT
 OF TRANSPORTATION
 DISTRICT 1

PUMP STATION
 STRUCTURAL
 SLAB PLAN

DATE: _____
 REVISION: _____
 BY: _____



1. ALL ROOFING SHALL BE DONE IN ACCORDANCE WITH THE LATEST EDITIONS OF THE F.P.S. SPECIFICATIONS.

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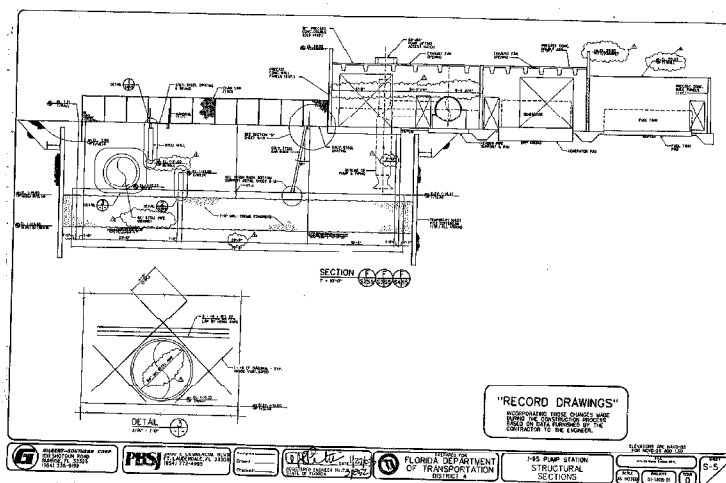
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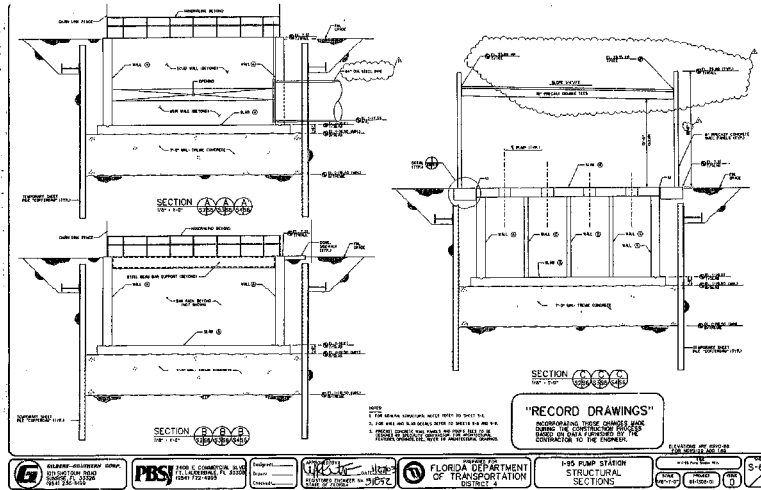
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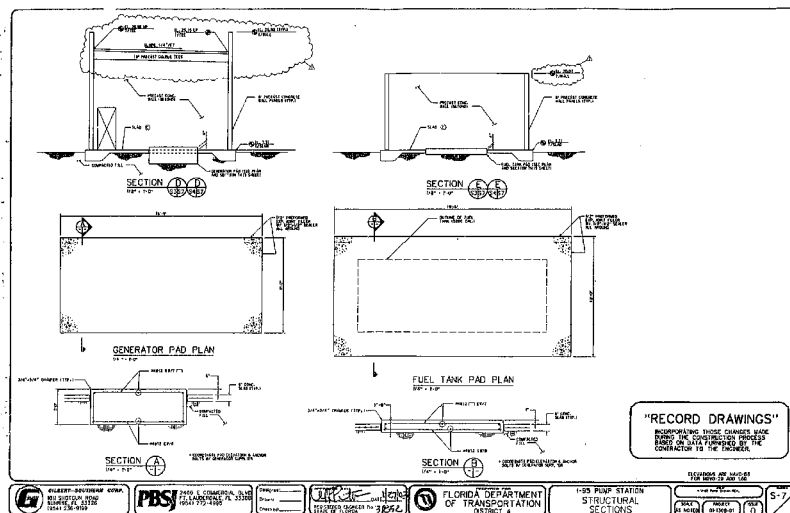
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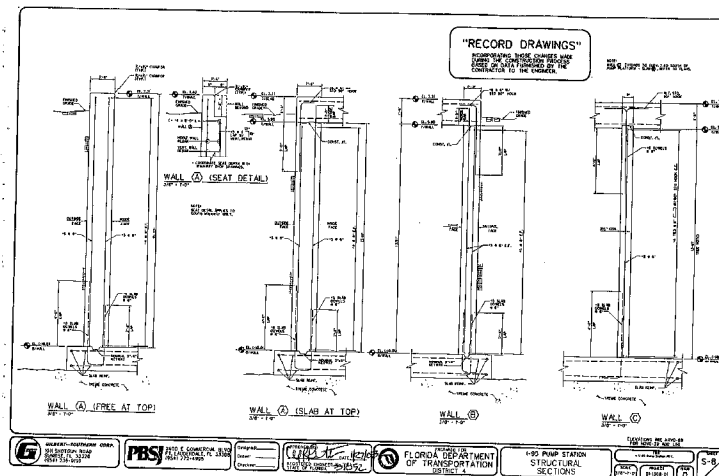
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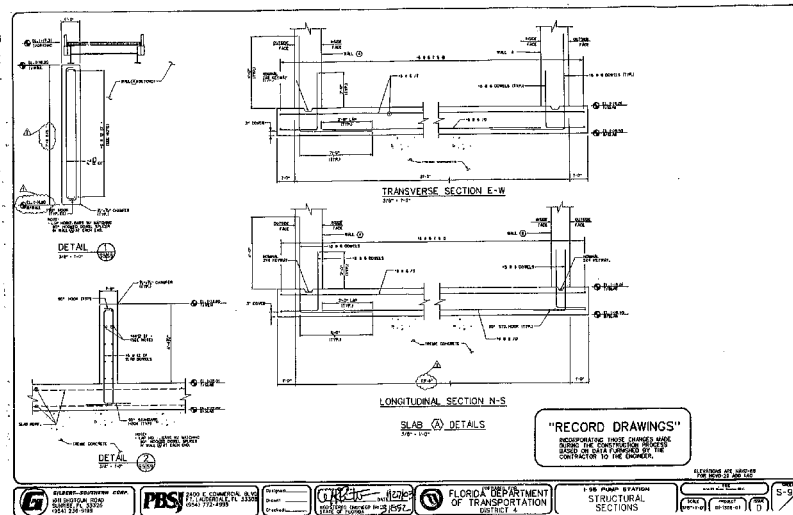
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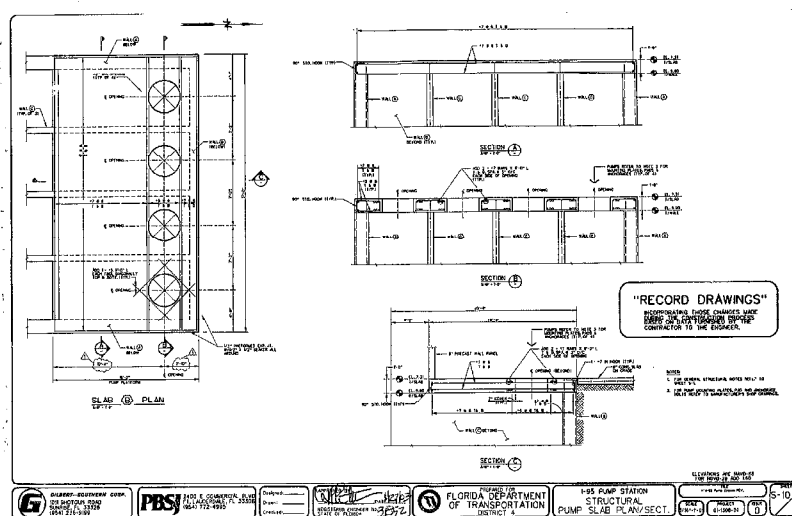


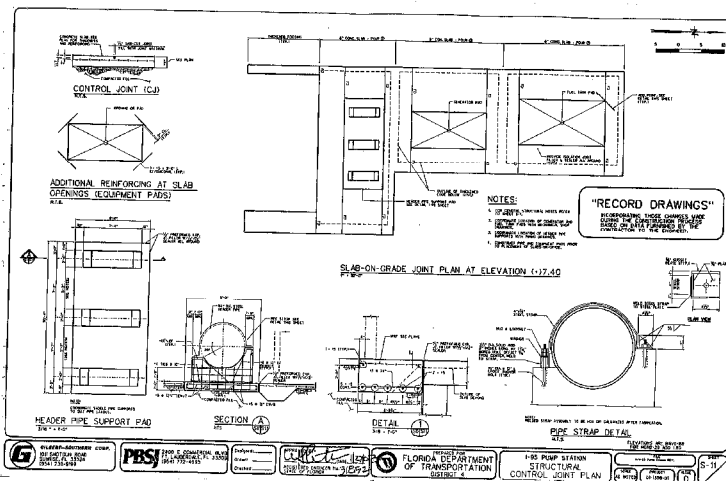




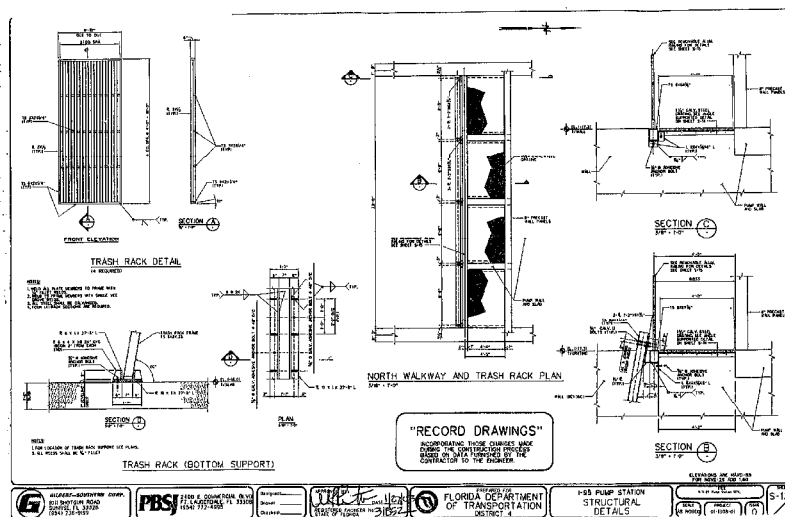


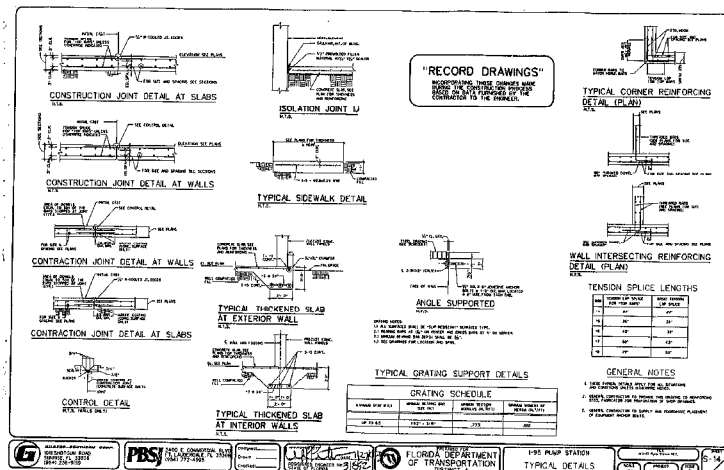


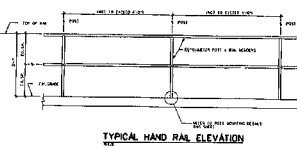










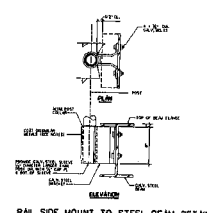


TYPICAL HAND RAIL ELEVATION
N.T.S.

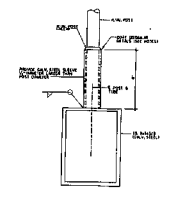
DESIGN LOADINGS FOR RAILINGS
 1. RAILINGS SHALL BE DESIGNED TO RESIST THE FOLLOWING LOADS:
 A. UNIFORM LOAD OF 20 LBS. PER LINEAL FOOT APPLIED TO THE RAIL.
 B. POINT LOAD OF 250 LBS. APPLIED TO THE RAIL.
 C. WIND LOAD OF 15 LBS. PER SQUARE FOOT OF RAIL AREA.
 D. THE RAIL SHALL BE DESIGNED TO RESIST THE FOLLOWING LOADS:
 1. UNIFORM LOAD OF 20 LBS. PER LINEAL FOOT APPLIED TO THE RAIL.
 2. POINT LOAD OF 250 LBS. APPLIED TO THE RAIL.
 3. WIND LOAD OF 15 LBS. PER SQUARE FOOT OF RAIL AREA.

NOTES:
 1. RAILINGS SHALL BE DESIGNED TO RESIST THE FOLLOWING LOADS:
 A. UNIFORM LOAD OF 20 LBS. PER LINEAL FOOT APPLIED TO THE RAIL.
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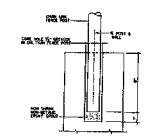
"RECORD DRAWINGS"
 INFORMATION HEREIN IS TO BE USED BY THE CONTRACTOR TO THE ENGINEER.



RAIL SIDE MOUNT TO STEEL BEAM DETAIL
 AT SOUTH WALKWAY (REMOVABLE)
 N.T.S.



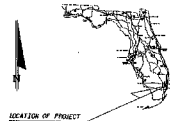
RAIL TOP MOUNTED TO STEEL TUBE DETAIL
 AT NORTH WALKWAY (REMOVABLE)
 N.T.S.



CHAIN LINK FENCE POST MOUNTED
 TO CONCRETE WALL DETAIL
 N.T.S.

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I-95 PUMP STATION
BROWARD COUNTY
STORMWATER IMPROVEMENT PROJECT
FINANCIAL PROJECT ID: 409733 1 52 01



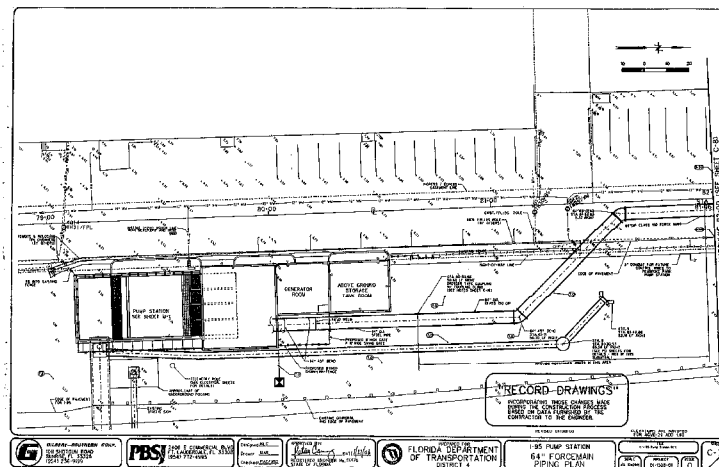
64" FORCE MAIN
SUBMITTAL No. 017R1

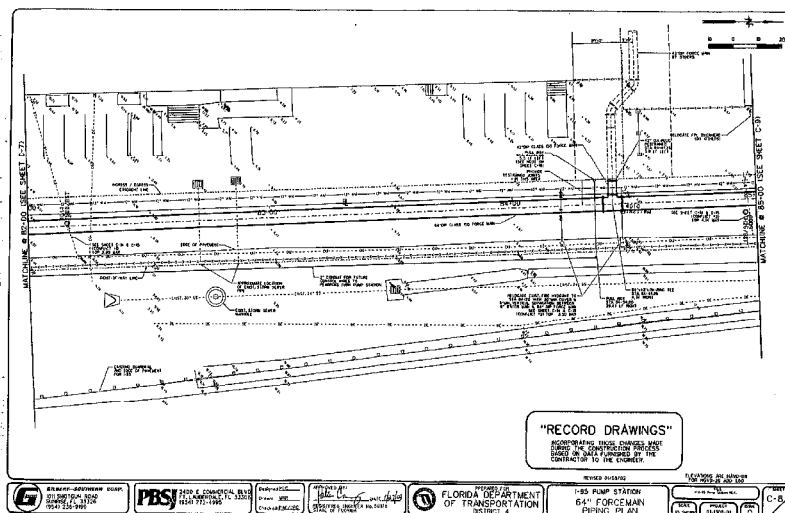
JANUARY 2002

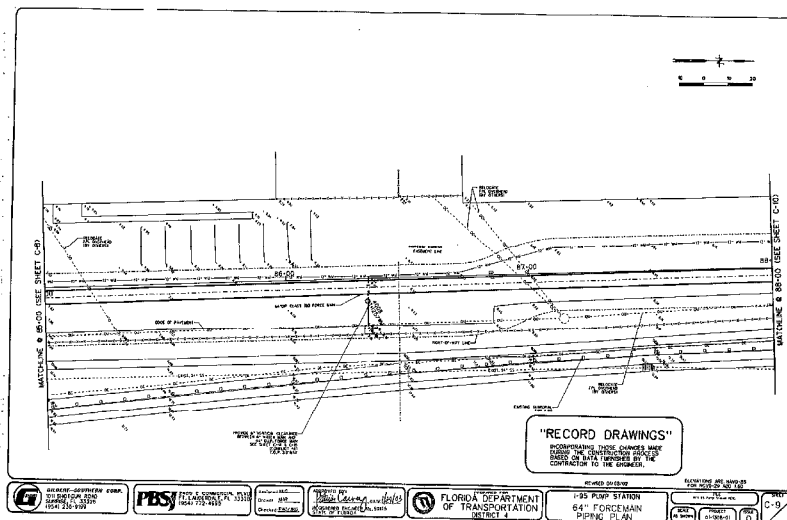
"RECORD DRAWINGS"
INCORPORATING THOSE CHANGES MADE
DURING THE CONSTRUCTION PROCESS
BASED ON DATA FURNISHED BY THE
CONTRACTOR TO THE ENGINEER

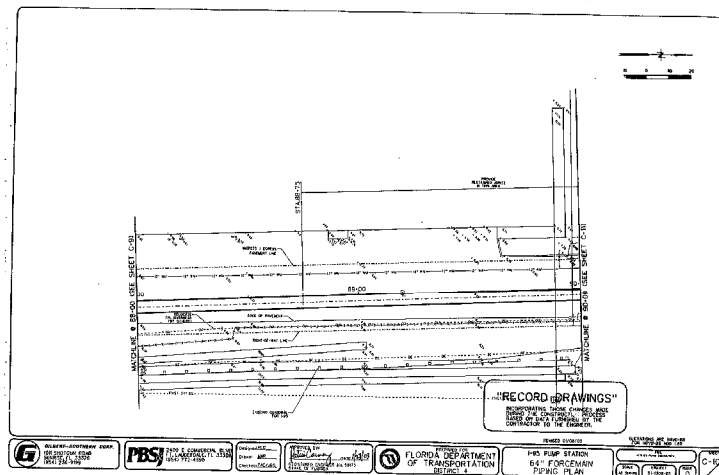


DEPT. OF COMMERCE, BUREAU OF
FISHING, WASHINGTON, D. C. 20540









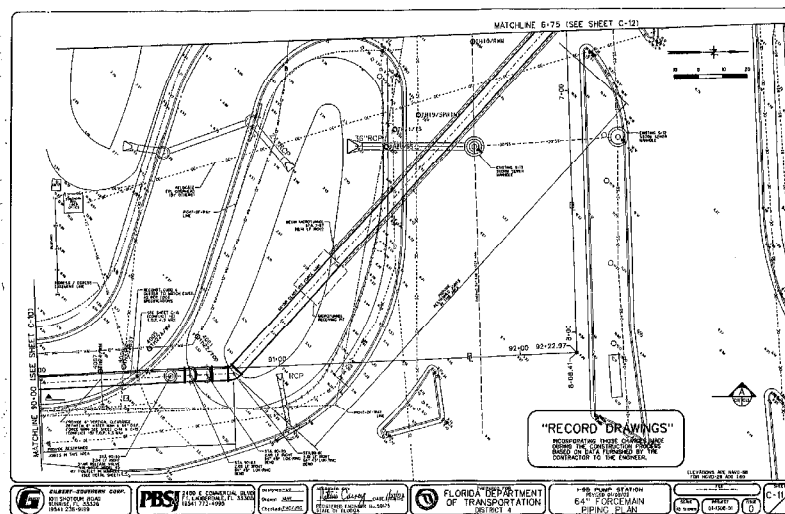
G GENERAL CONTRACTOR
DESIGNED BY
DATE 10-1-60

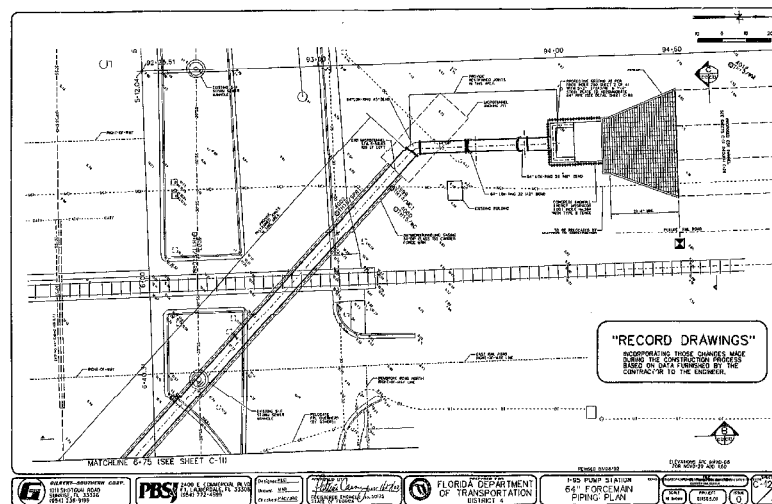
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DESIGNED BY
DATE 10-1-60

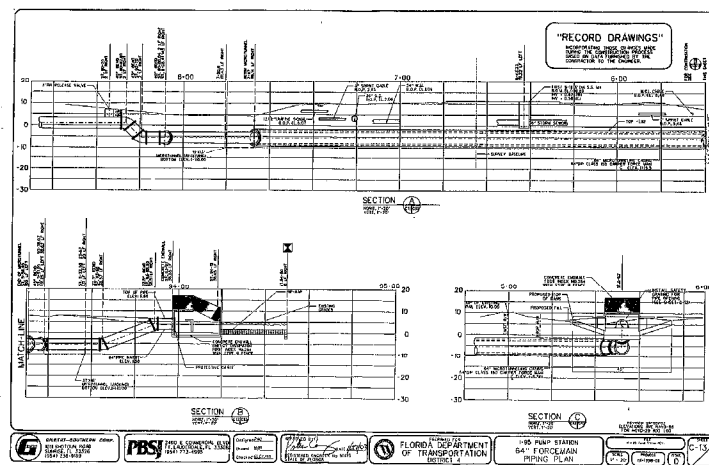
FLORIDA DEPARTMENT OF TRANSPORTATION
DESIGNED BY
DATE 10-1-60

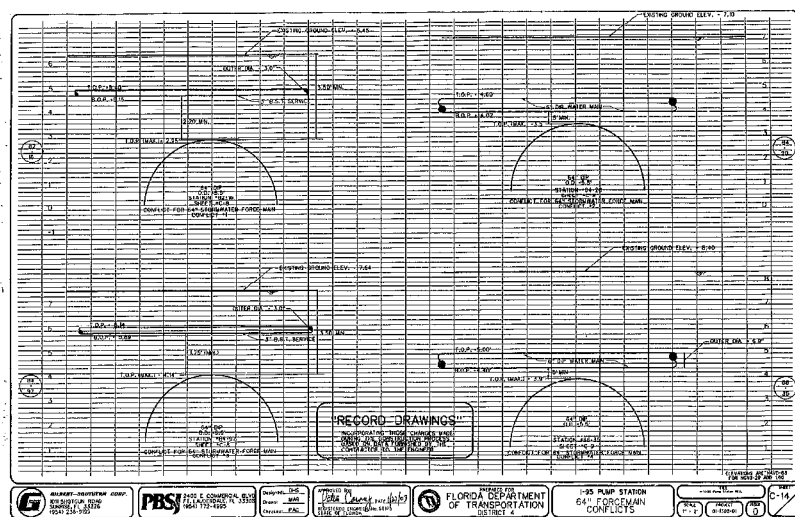
145 PUMP STATION
64" FORCEMAN
PUMP PLAN

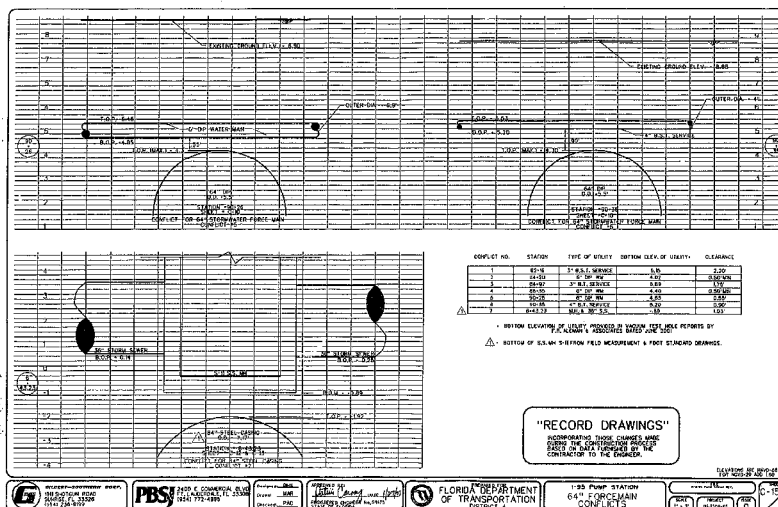
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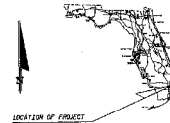






SHEET NO.	SHEET DESCRIPTION
C-1	LAKE INTERCONNECT CHANNEL
C-2	SCHOOL BOILING LAKE PARTIAL SITE PLAN
C-2A	NOTES AND LEGEND
E-1	LAKE INTERCONNECT SECTION
H-6	STILLING WEIR DETAILS
E-7	STILLING WEIR ELECTRICAL PLAN

I-95 PUMP STATION
BROWARD COUNTY
STORMWATER IMPROVEMENT PROJECT
FINANCIAL PROJECT ID: 409733 1 52 01



NEW SALT ROUTINE

REV SHEET ADDITIONS		
DATE	BY	DESCRIPTION
1/22/00	AK	ADDITIONS AS PER CDS COMMENTS

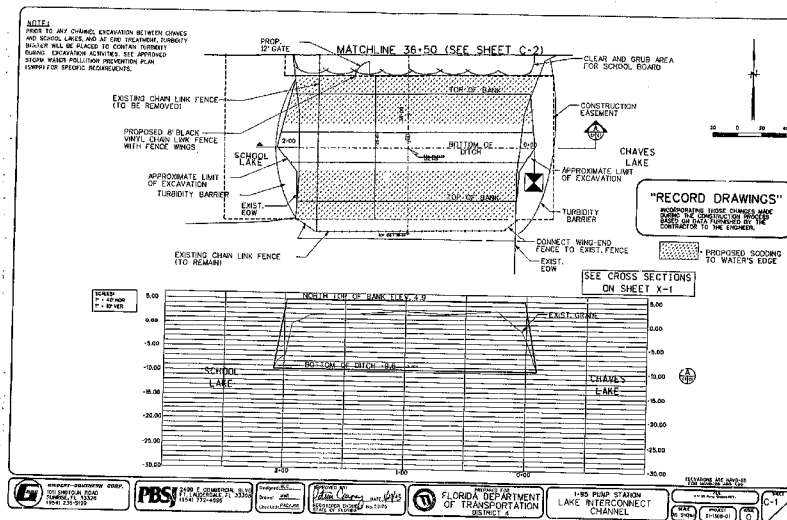


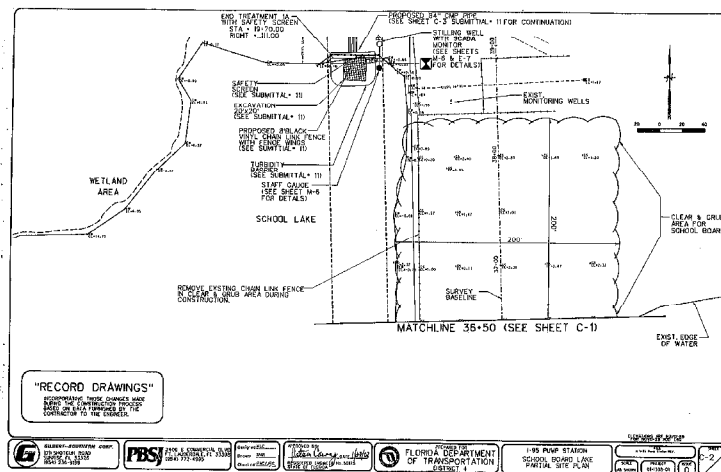
GILBERTSOUTHERN CORP
1011 SHOTGUN ROAD
SUNRISE, FL 33328
(954) 238-0100

"RECORD DRAWINGS"

INCORPORATING THOSE CHANGES MADE DURING THE CONSTRUCTION PROCESS BASED ON DATA FURNISHED BY THE CONTRACTOR TO THE ENGINEER.

PBS



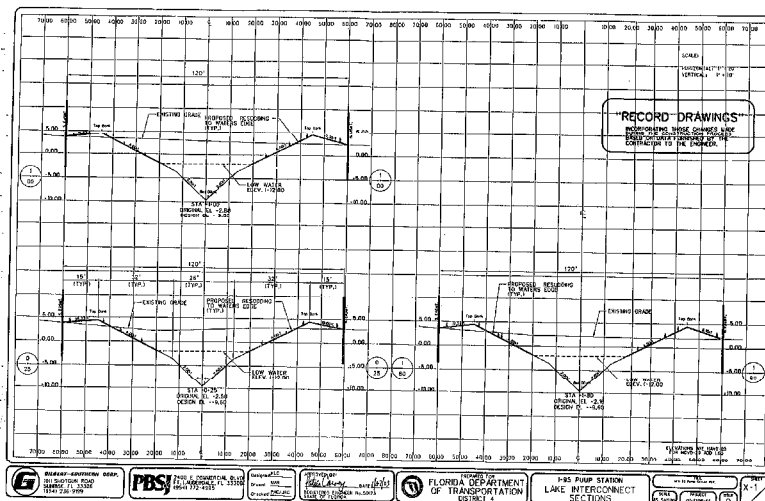


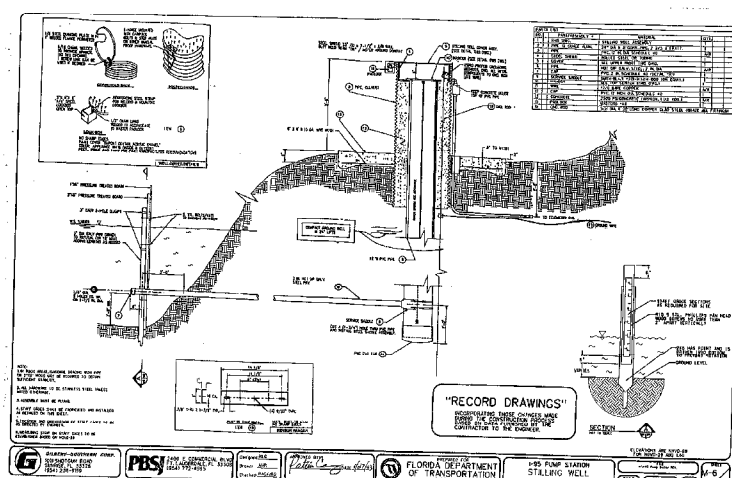
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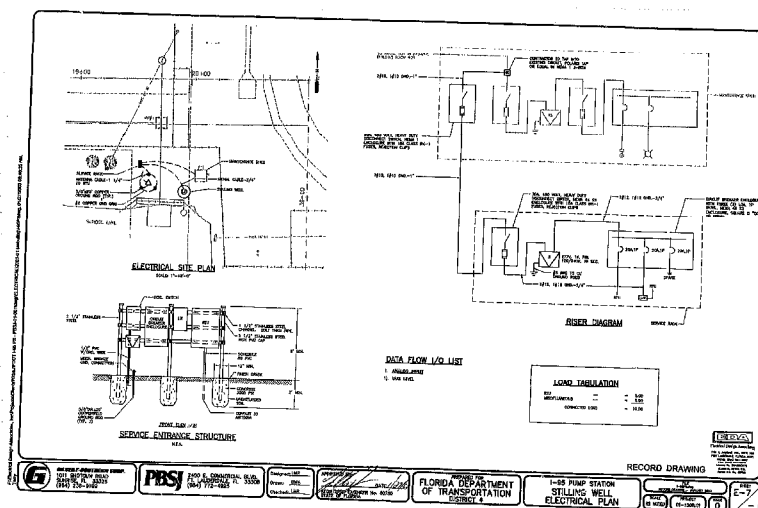
RECORD DRAWING
INCORPORATING THESE CHANGES MADE
DURING THE CONSTRUCTION PROCESS
BASED ON DATA FURNISHED BY THE
CONTRACTOR TO THE ENGINEER.

BSU/BSZ	-BLK. SOUTH TELEPHONE
BU	-UNDERGROUND UTILITY
BUP	-BACKFLOW PREVENTER
C	-CATCHPILE
CL	-CONCRETE LINE
CM	-CUTTING MARK
EDP	-ELECTRIC WDM PIPE
EDV	-EDGE OF PAVEMENT
ES	-CABLE
FS	-FLOW SIGN
FW	-BOTTOM OF PIPE
TOP	-TOP OF MAN
DDW	-BOTTOM OF MANHOLE
X-X	-CHAIN LINK FENCE
DC	-OVERHEAD ELECTRIC
DE	-BURIED ELECTRIC
MC	-CABLE
SC	-SPRINK CABLE
PCP	-PREFORMED CONCRETE
TS	-TRAFFIC SIGNAL CABLE
PCW	-PIPE WITH A CAP
CB	-CATCH BASIN
GS	-GROUND SURFACE
EW	-EDGE OF WATER









INDEX OF PLANS

SHEET NO. DRAWING TITLE
 W-1 PUMP STATION MECHANICAL PLAN
 W-2 PUMP STATION ELECTRICAL
 W-3 PUMP STATION MECHANICAL NOTES
 D-1 DETAILS & TIE-INS
 E-1 ELECTRICAL SYMBOLS & MONITORING
 E-2 ELECTRICAL SYMBOLS & MONITORING
 E-3 ELECTRICAL SYMBOLS & MONITORING
 E-4 ELECTRICAL SYMBOLS & MONITORING
 E-5 ELECTRICAL SYMBOLS & MONITORING
 E-6 ELECTRICAL SYMBOLS & MONITORING
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STATE OF FLORIDA
 DEPARTMENT OF TRANSPORTATION

I-95 PUMP STATION
 BROWARD COUNTY
 STORMWATER IMPROVEMENT PROJECT
 FINANCIAL PROJECT ID: 409733 1 52 01



PUMP STATION
 MECHANICAL, ELECTRICAL,
 PLUMBING AND HVAC
 SUBMITTAL No. 019R2

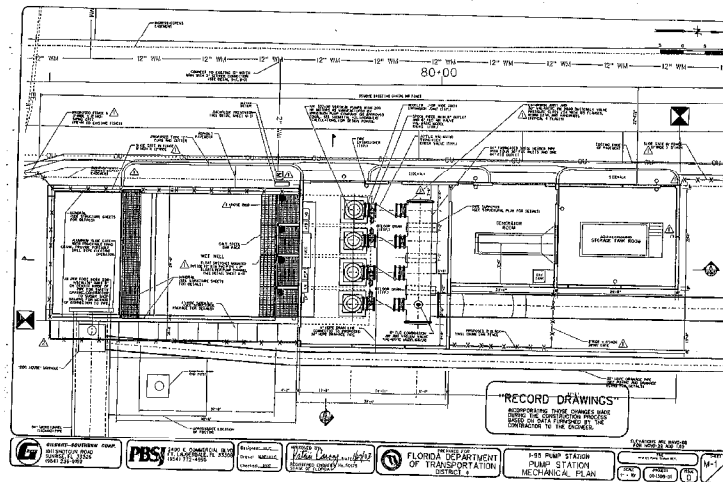
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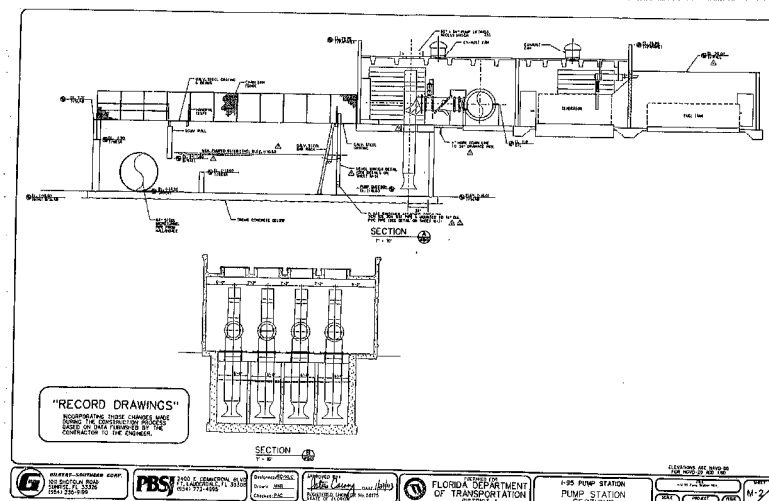
PUMP STATION REVISIONS			
NO.	BY	DATE	REVISION
1	PE	05/01/02	REVISION 1 - SEE COMMENTS
2	PE	05/01/02	REVISION 2 - SEE COMMENTS



"RECORD DRAWINGS"
 DRAWING TO BE USED FOR CONSTRUCTION
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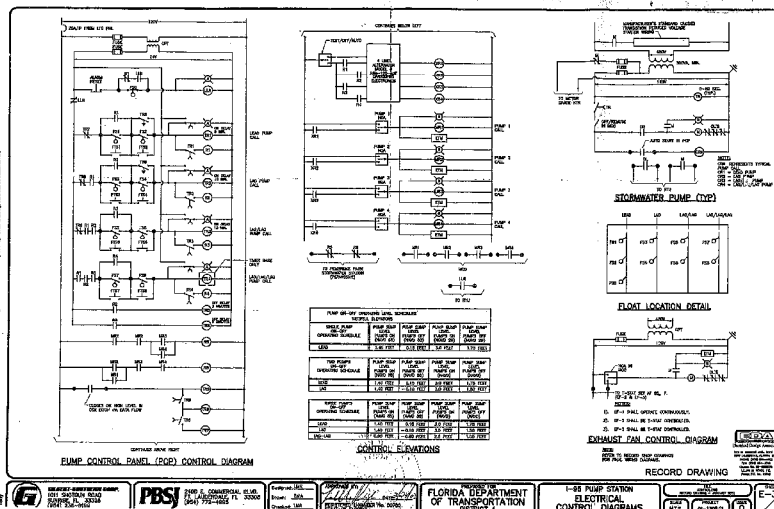






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DESIGNED BY
DRAWN BY
CHECKED BY
DATE

PBS

FLORIDA DEPARTMENT
OF TRANSPORTATION
DISTRICT 4

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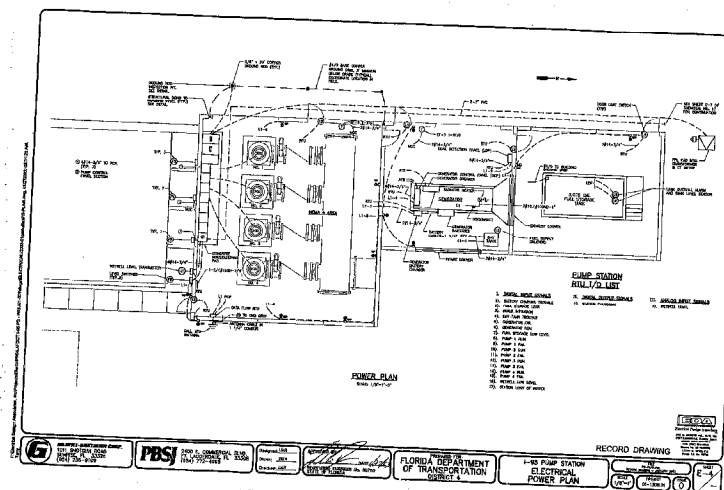
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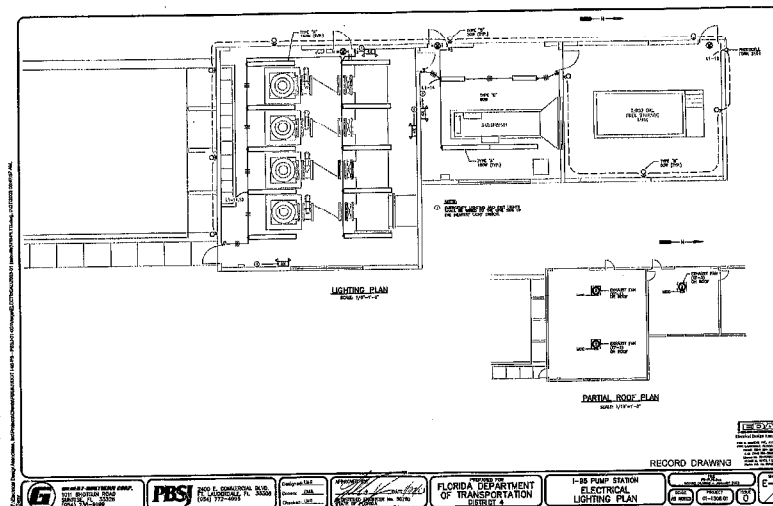
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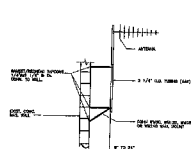
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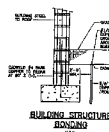




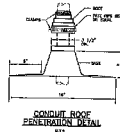
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CH. NO.		DESCRIPTION					
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3	3	LINE POWER	120	1	115.00 V	115.00 V	0.00
4	4	LINE POWER	120	1	115.00 V	115.00 V	0.00
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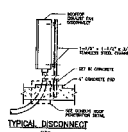
STANDARD WALL MOUNT
RTU ANTENNA & MAST INSTALLATION



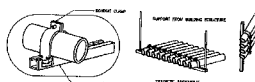
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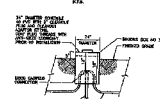
CONDUIT ROOF
PENETRATION DETAIL
83A



TYPICAL DISCONNECT



CONDUIT PIPE STRAP MOUNTING DETAIL

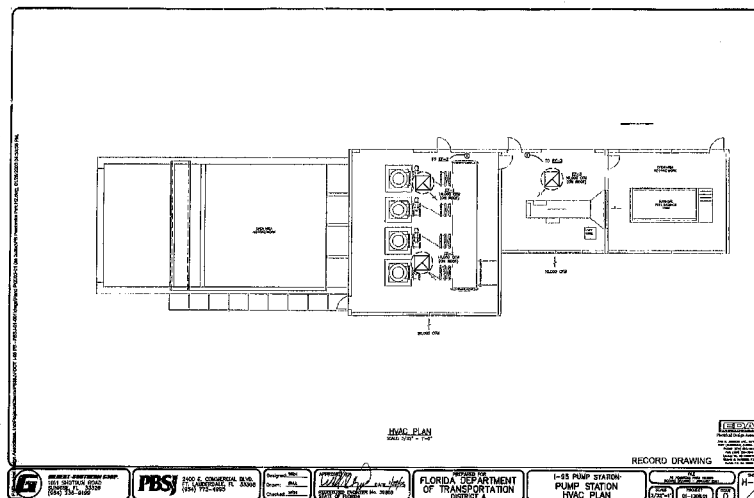









GROUND TEST PIT DETAIL

RECORD DRAWING

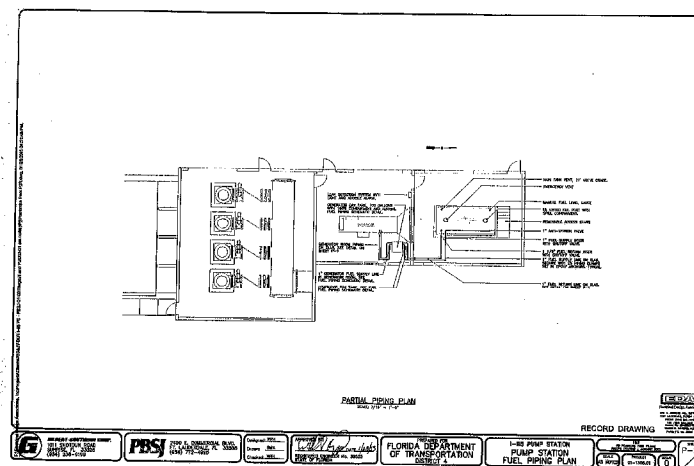


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650

"RECORD DRAWINGS"
 THESE DRAWINGS ARE TO BE
 USED AS A GUIDE BY THE
 CONTRACTOR TO BE BUILT.

**STATE OF FLORIDA
 DEPARTMENT OF TRANSPORTATION**

CONTRACT PLANS

FINANCIAL PROJECT ID 409733-1-52-01

BROWARD COUNTY

I-95 PUMP STATION
 S.W. 30th AVENUE

PAVING AND DRAINAGE PLANS

INDEX OF ROADWAY PLANS

SHEET NO.	SHEET DESCRIPTION
101	GENERAL NOTES
102	PAVING AND DRAINAGE
103	PAVING AND DRAINAGE
104	PAVING AND DRAINAGE
105	PAVING AND DRAINAGE

PLANS PREPARED BY:
 S. A. BEHAR & COMPANY
 100 S.E. 10th AVENUE
 FORT LAUDERDALE, FL 33316
 LICENSED PROFESSIONAL ENGINEER
 OF AUTHORIZATION NO. 115 000 000

WITH THE APPROVAL OF THE BOARD OF
 PUBLIC WORKS OF THE COUNTY OF BROWARD



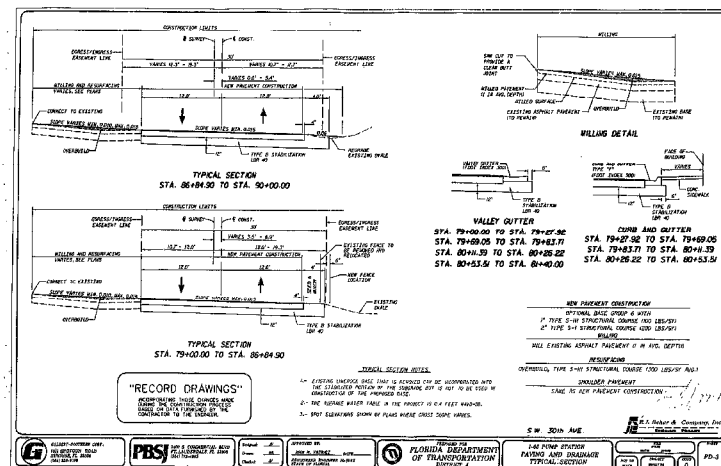
NOTHING SHOWN ON THESE PLANS
 SHALL BE CONSIDERED AS A GUARANTEE
 OF THE ACCURACY OF THE INFORMATION
 HEREON. THE USER OF THESE PLANS
 SHALL BE RESPONSIBLE FOR THE
 RESULTS OF ANY ACTION TAKEN
 BASED ON THESE PLANS.

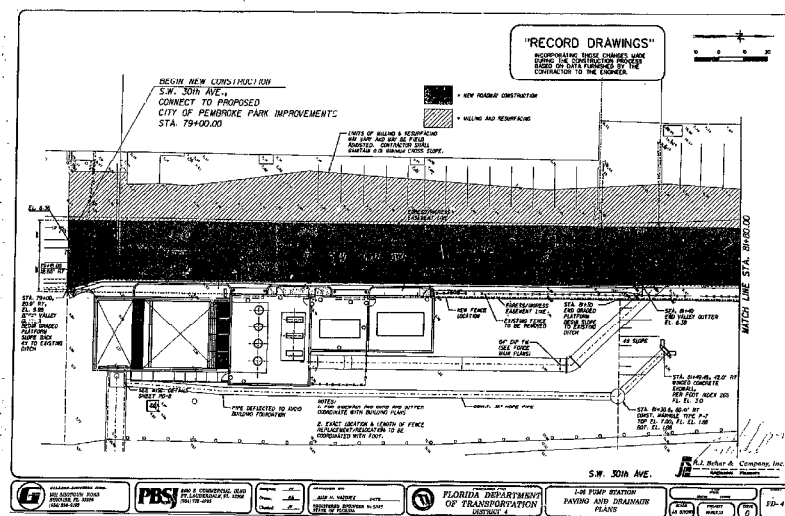
NO. SHEET	REVISION
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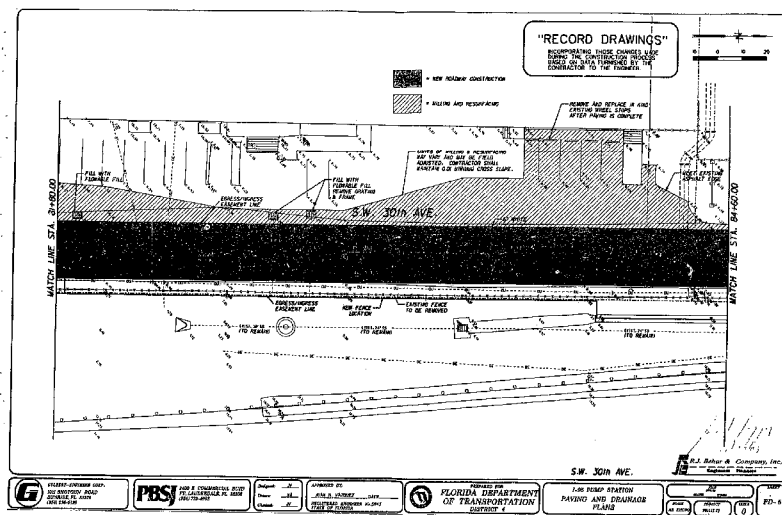
[Signature]
 S. A. BEHAR & COMPANY
 ENGINEER

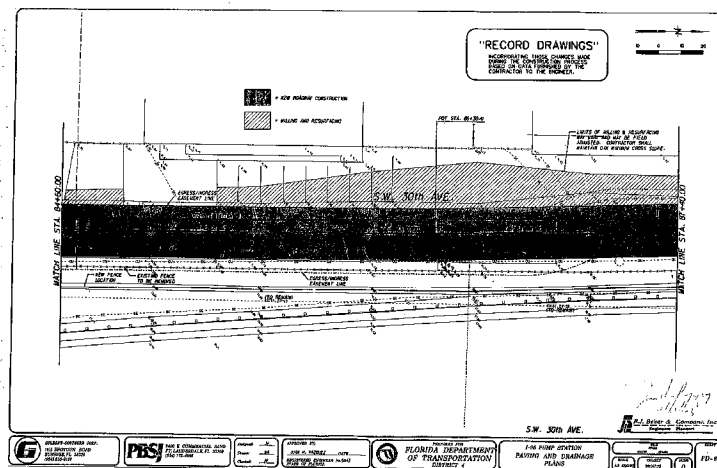
DIRECT
 NO.
 PD-4

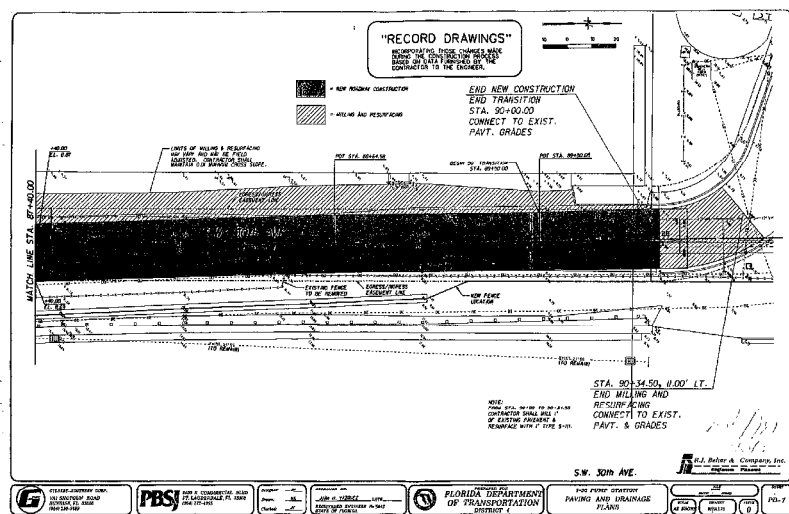
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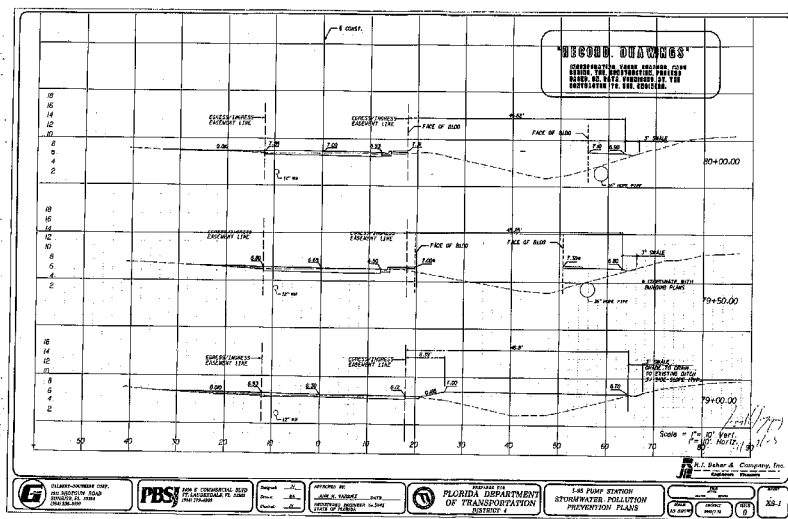


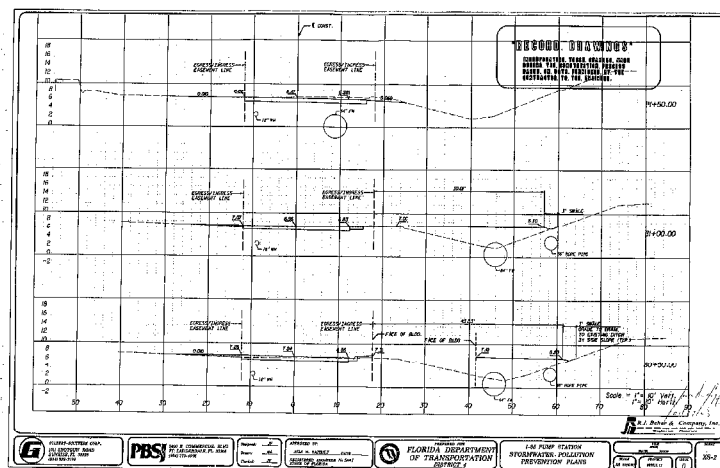


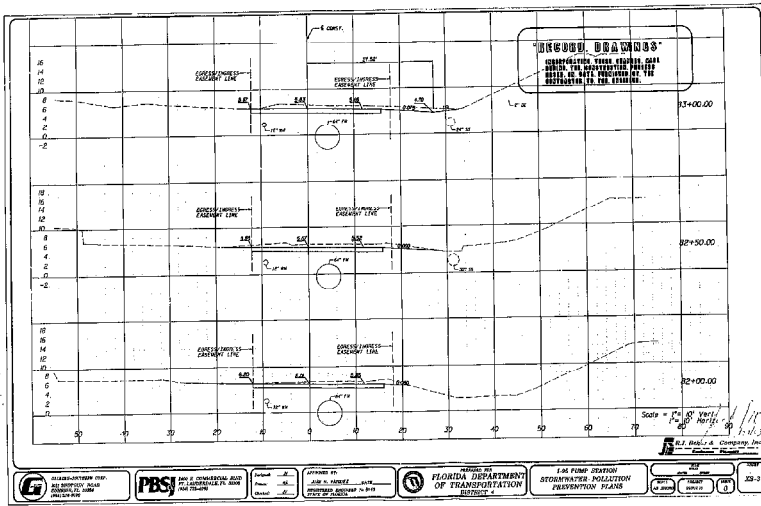












DESIGNED BY: J. M. H.

CHECKED BY: J. M. H.

APPROVED BY: J. M. H.

FLORIDA DEPARTMENT OF TRANSPORTATION

STORMWATER POLLUTION PREVENTION PLAN

15+00.00

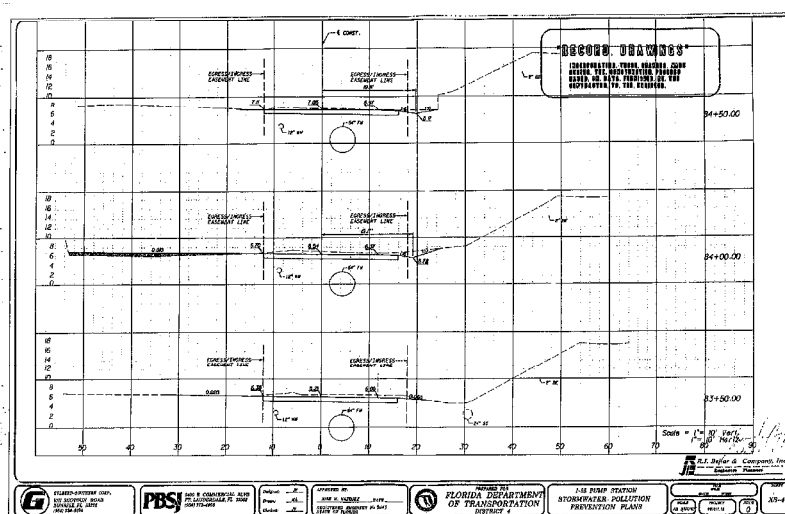
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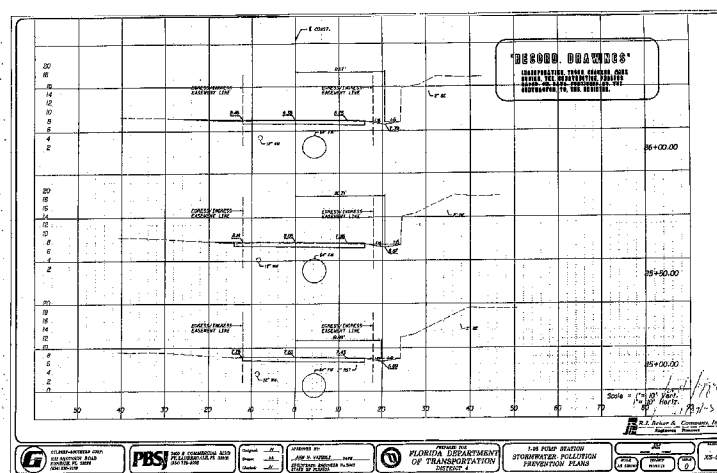
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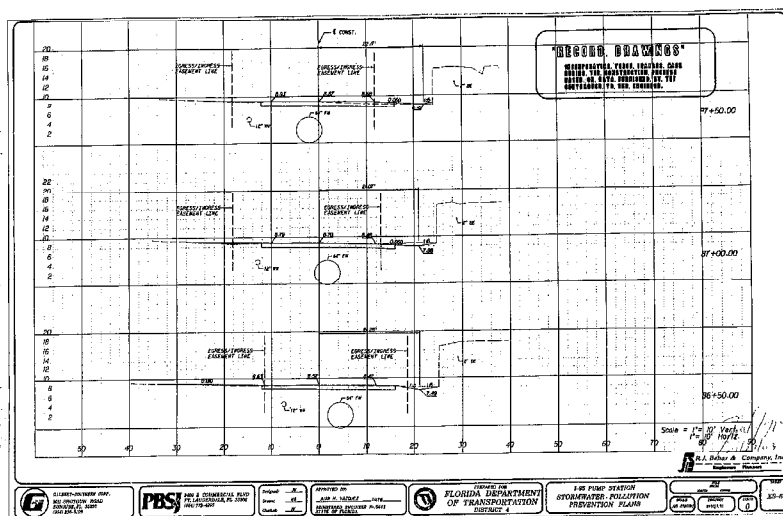
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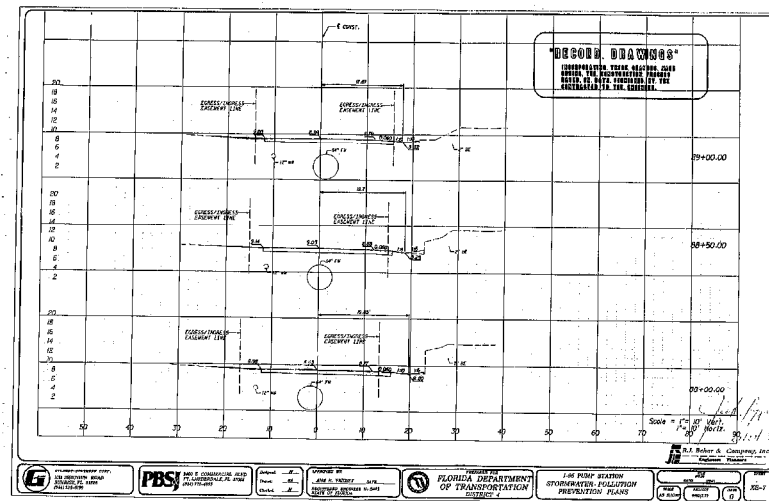
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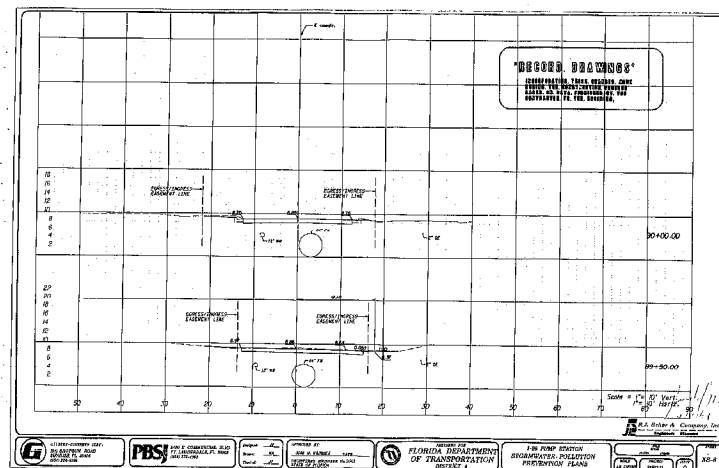
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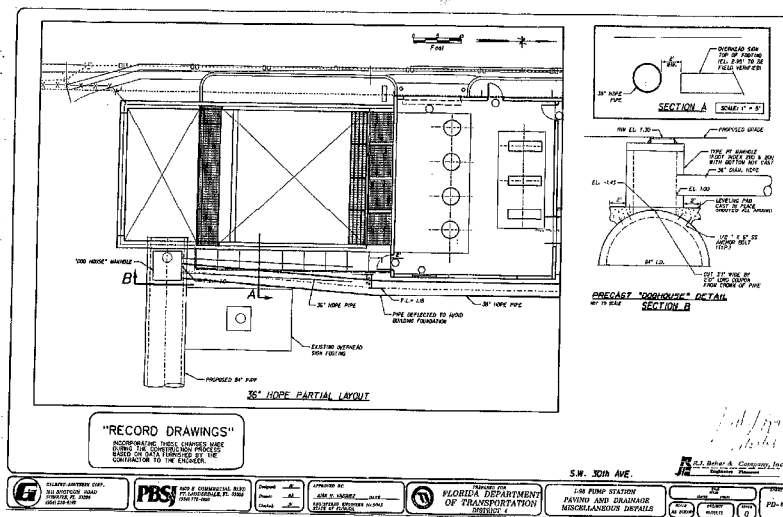










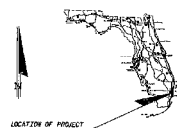


INDEX OF PLANS

SHEET NO.	SHEET DESCRIPTION
A-1	COVER PLAN
A-2	BOX PLAN
A-3	ELEVATION
A-4	SECTION
A-5	SECTION
A-6	SECTION
A-7	SECTION
A-8	SECTION
A-9	SECTION
A-10	SECTION
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A-99	SECTION
A-100	SECTION

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

I-95 PUMP STATION
BROWARD COUNTY
STORMWATER IMPROVEMENT PROJECT
FINANCIAL PROJECT ID: 409733 1 52 01



PUMP STATION
ARCHITECTURAL
SUBMITTAL No. 039R1

APRIL 2002

FOR SHEET REVISIONS

DATE	BY	REVISION
04/01/02	03	REVISION 1



DESIGNED BY: GILBERTSON CORP.
8011 SHILOH ROAD
SUITE 300
FORT LAUDERDALE, FL 33308
(954) 256-1000

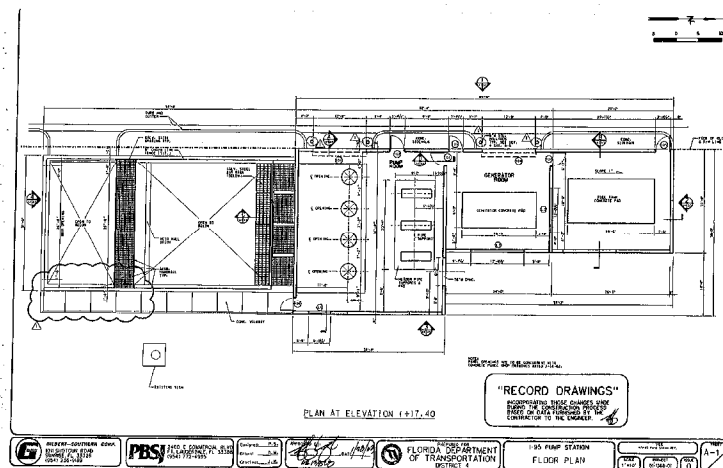
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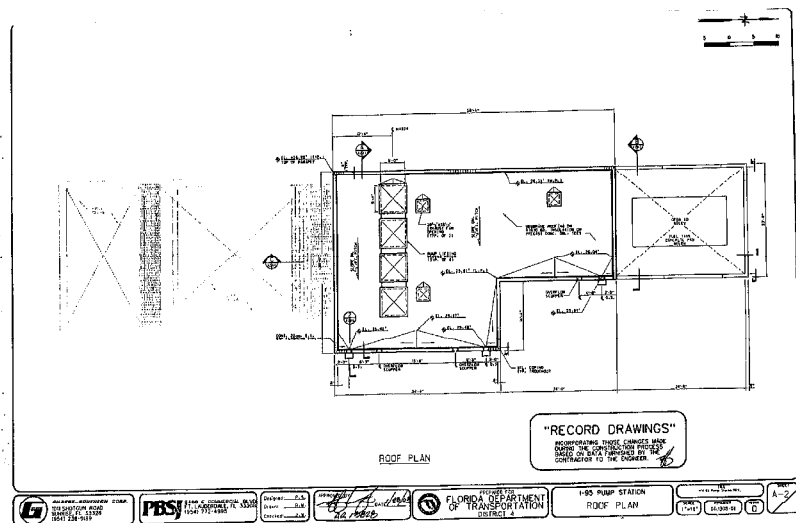
NO REVISIONS TO BE MADE
BASED ON THE RECORD OF THE
CONTRACTOR TO THE ENGINEER.



PROFESSIONAL SEAL
OF THE STATE OF FLORIDA
ARCHITECT

[Signature]
10/20/02





DESIGNED BY
DRAWN BY
CHECKED BY
APPROVED BY

FLORIDA DEPARTMENT OF
TRANSPORTATION
DISTRICT 4

DESIGNED BY
DRAWN BY
CHECKED BY
APPROVED BY

FLORIDA DEPARTMENT OF
TRANSPORTATION
DISTRICT 4

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DRAWN BY
CHECKED BY
APPROVED BY

FLORIDA DEPARTMENT OF
TRANSPORTATION
DISTRICT 4

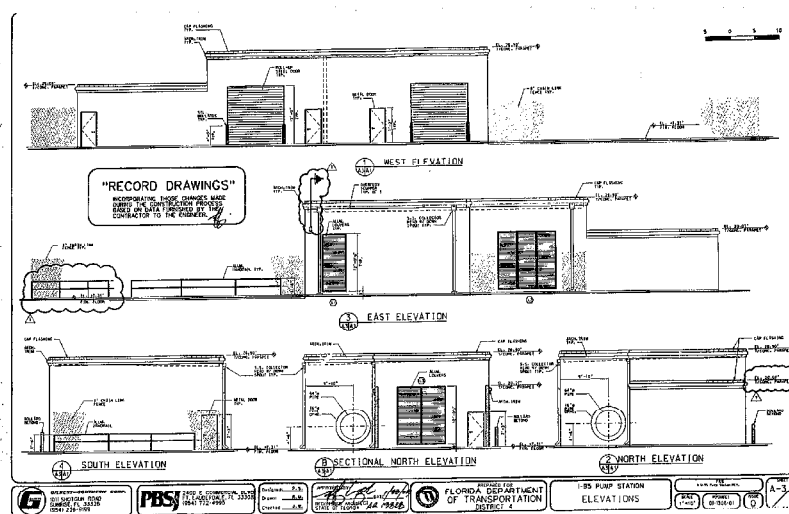
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DRAWN BY
CHECKED BY
APPROVED BY

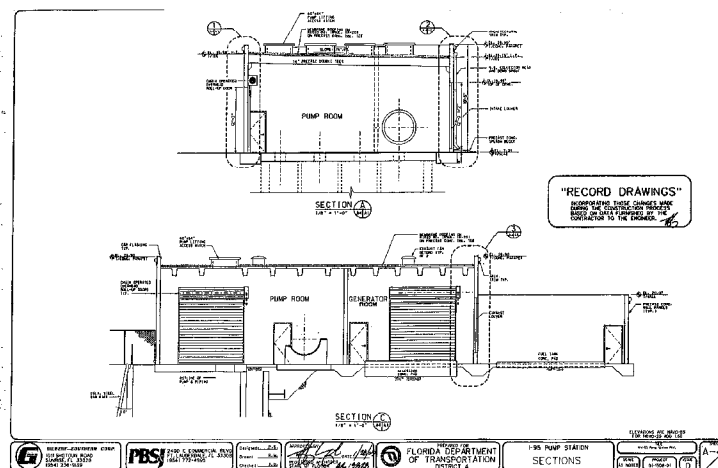
FLORIDA DEPARTMENT OF
TRANSPORTATION
DISTRICT 4

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APPROVED BY

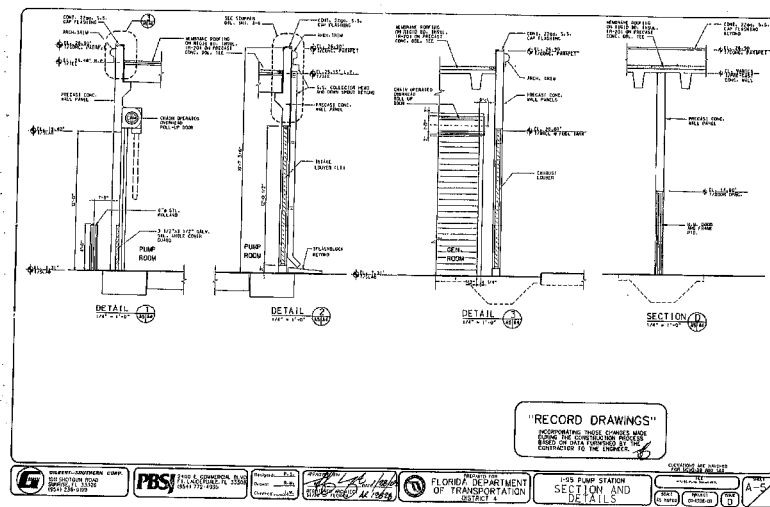
FLORIDA DEPARTMENT OF
TRANSPORTATION
DISTRICT 4

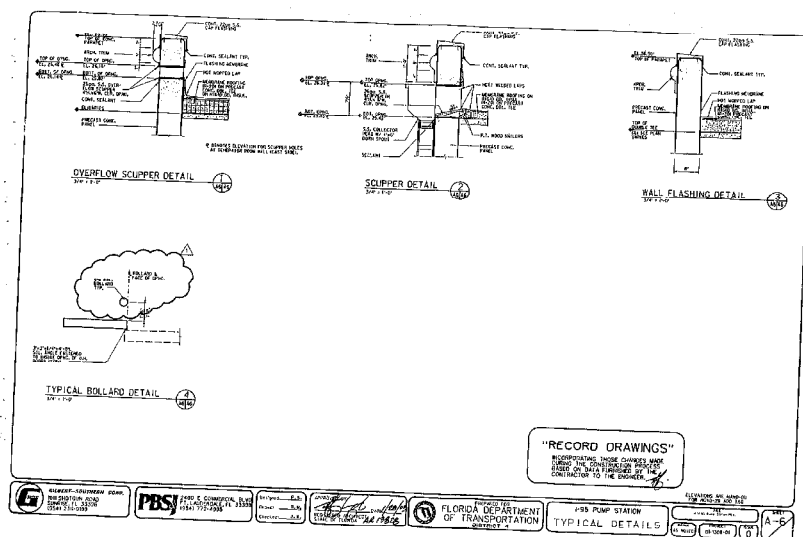
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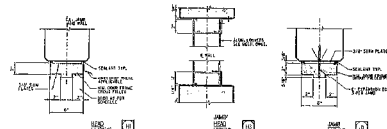
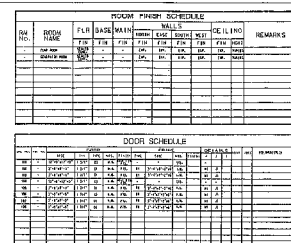




FLORIDA DEPARTMENT OF TRANSPORTATION
 DIVISION OF HIGHWAYS
 PROJECT NO. 1A-1000
 SHEET NO. 1A-1000
 DATE: 10/1/80
 DRAWN BY: J. L. BROWN
 CHECKED BY: J. L. BROWN
 APPROVED BY: J. L. BROWN
 TITLE: PUMP STATION SECTIONS
 SCALE: 1/8" = 1'-0"







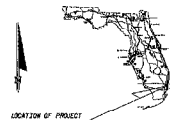
"RECORD DRAWINGS"
INCORPORATING THOSE CHANGES MADE
DURING THE CONSTRUCTION PROCESS
BASED ON DATA FURNISHED BY THE
CONTRACTOR TO THE ENGINEER

INDEX OF PLANS

SHEET NO.	SHEET DESCRIPTION
C-101	100' CHANNEL PUMP W/ PUMP JAIL
C-102	800' CHANNEL
C-103	100' CHANNEL
C-104	100' CHANNEL
C-105	100' CHANNEL
C-106	100' CHANNEL
C-107	100' CHANNEL
C-108	100' CHANNEL
C-109	100' CHANNEL
C-110	100' CHANNEL
C-111	100' CHANNEL
C-112	100' CHANNEL
C-113	100' CHANNEL
C-114	100' CHANNEL
C-115	100' CHANNEL
C-116	100' CHANNEL
C-117	100' CHANNEL
C-118	100' CHANNEL
C-119	100' CHANNEL
C-120	100' CHANNEL

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

I-95 PUMP STATION
BROWARD COUNTY
STORMWATER IMPROVEMENT PROJECT
FINANCIAL PROJECT ID: 409733 1 52 01



LOCATION OF PROJECT



CSX CHANNEL
SUBMITTAL No. 041R1

MARCH 2002

REV	DESCRIPTION
1	REVISED
2	REVISED
3	REVISED
4	REVISED
5	REVISED
6	REVISED
7	REVISED
8	REVISED
9	REVISED
10	REVISED
11	REVISED
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20	REVISED



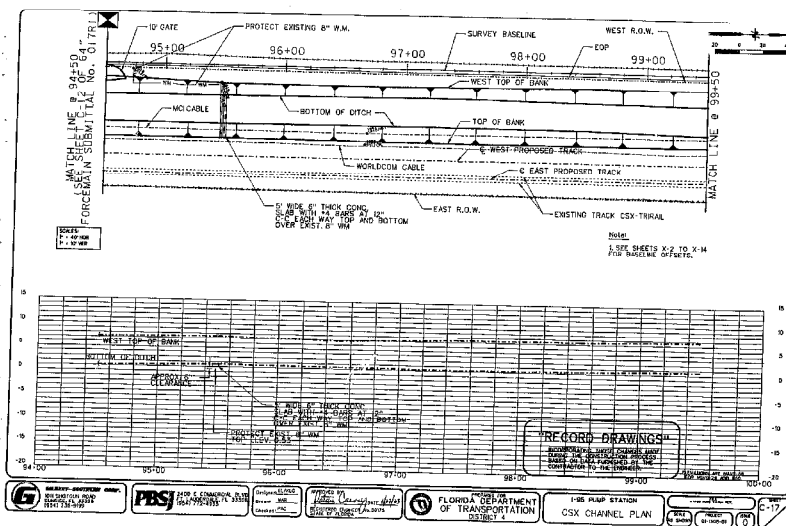
GILBERTS/DUNHAM CORP.
800 SHOFORD ROAD
SUNRISE, FL 33325
(954) 235-9189

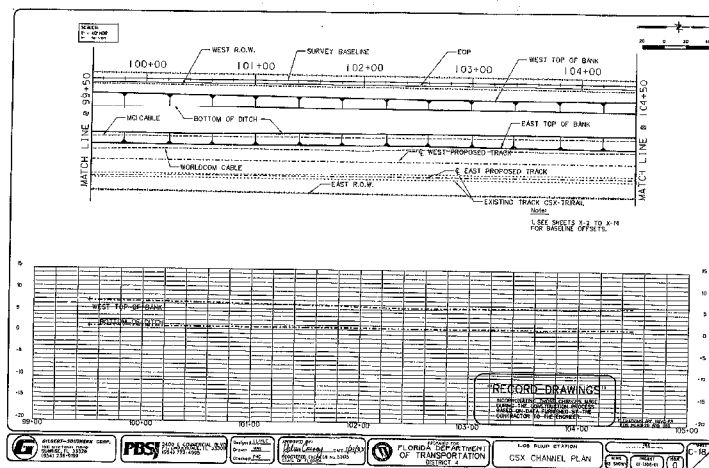
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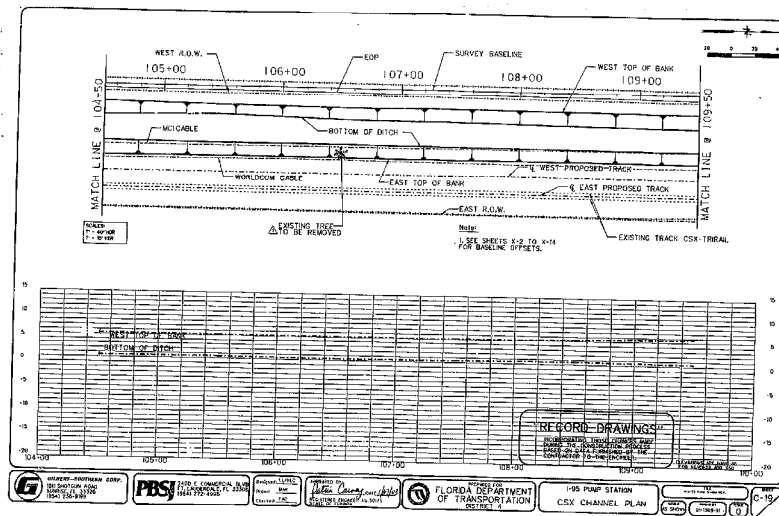
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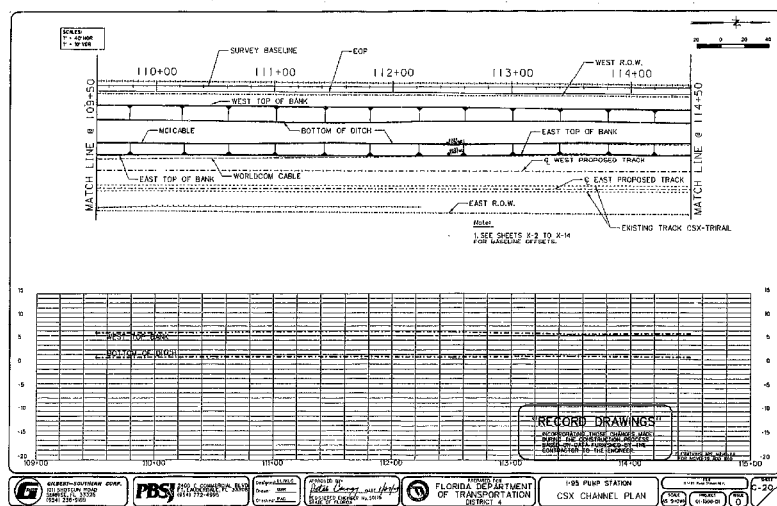
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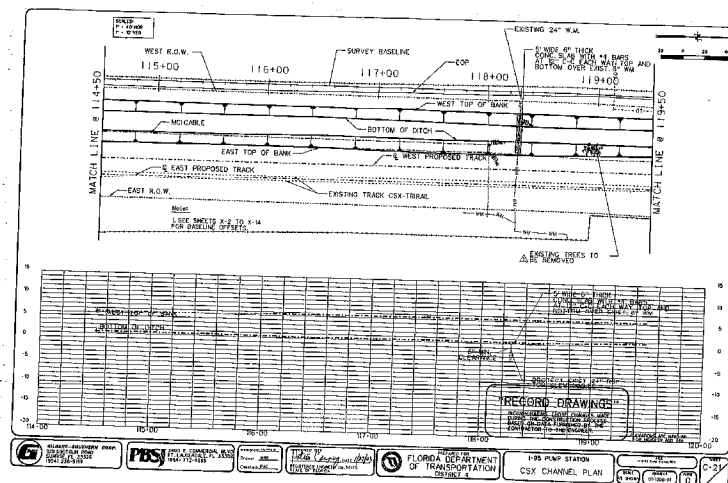
FOR A COMPLETE RECORD
DRAWING SET, SEE
DRAWING SET NO. 041R1

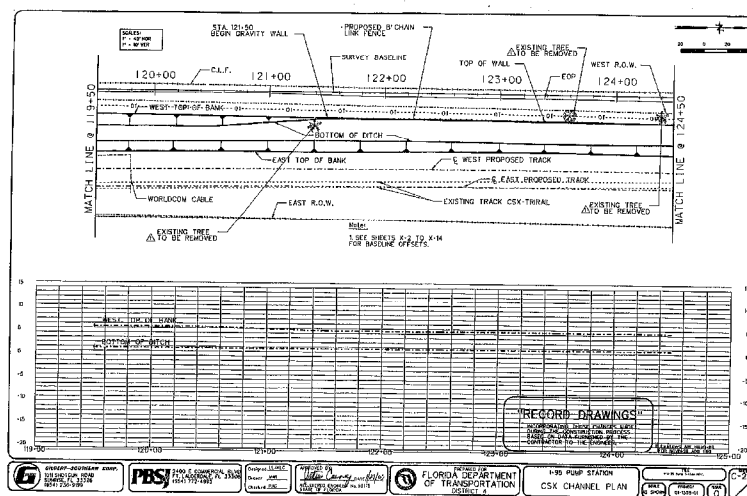


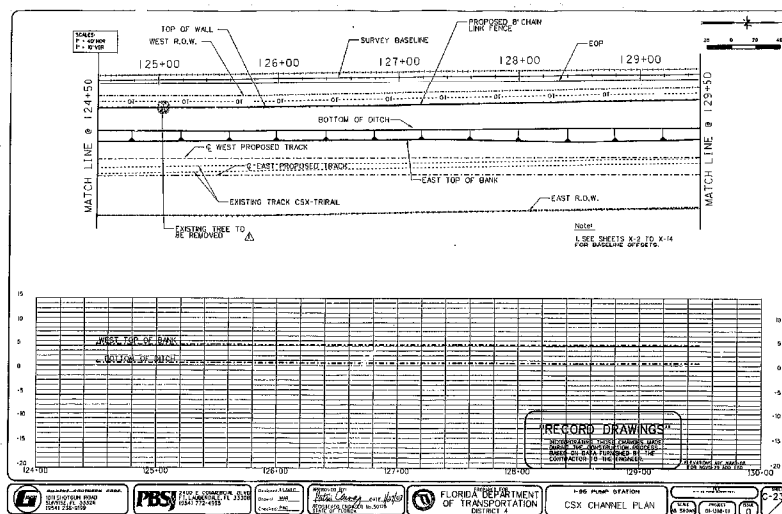


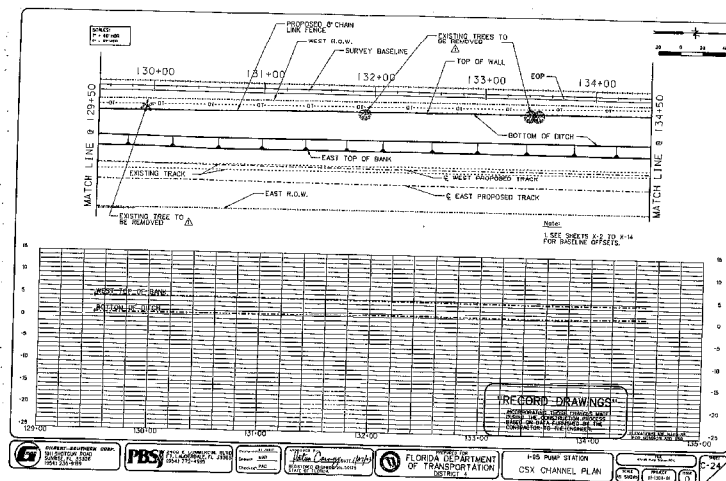




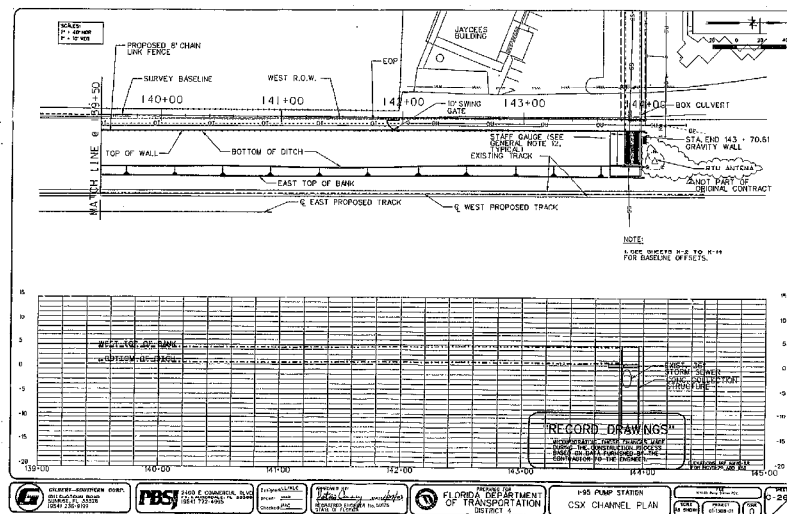


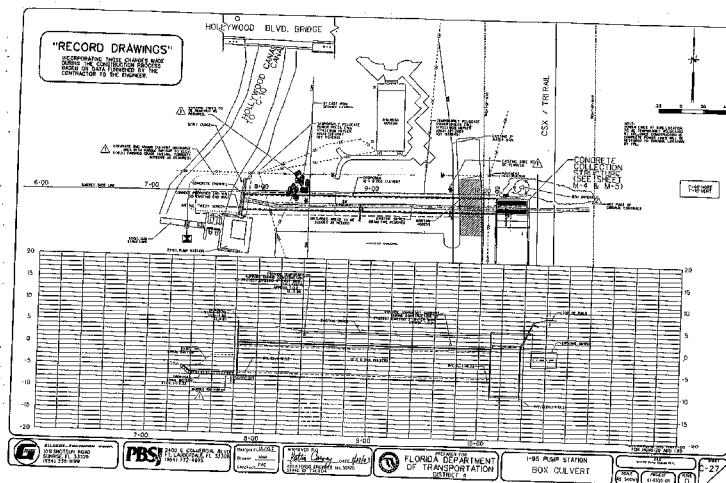


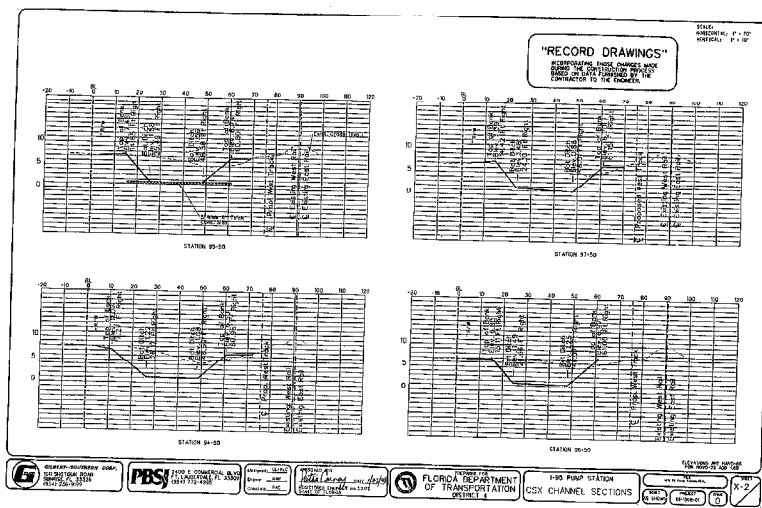




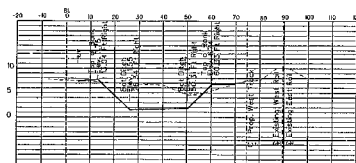




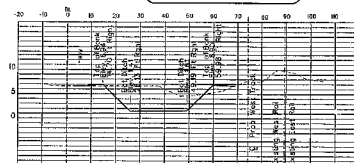




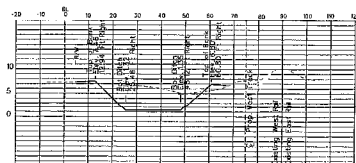
INCORPORATING THOSE CHANGES MADE DURING THE CONSTRUCTION PROCESS BASED ON DATA FURNISHED BY THE CONTRACTOR TO THE ENGINEER.



STATION 20-30



STATION 901-50



STAT 98.50



UNIVERSITY OF CALIFORNIA

GILBERT & SONNEAR CORP.
1201 540TH AVE. S.W.
SAKINOS, WY. 83320
724/261-9888

PBS 2400 E. COLUMBIA BLVD.
FT. LAUDERDALE, FL 33301
(954) 772-4595

Designated ELC
 Drawn gah
 Checked BAC

APPROVED BY
Patricia Curry DATE *10/10*
RECEIVED BY: [Signature] No. 50105


 PREPARED FOR
 FLORIDA DEPARTMENT
 OF TRANSPORTATION

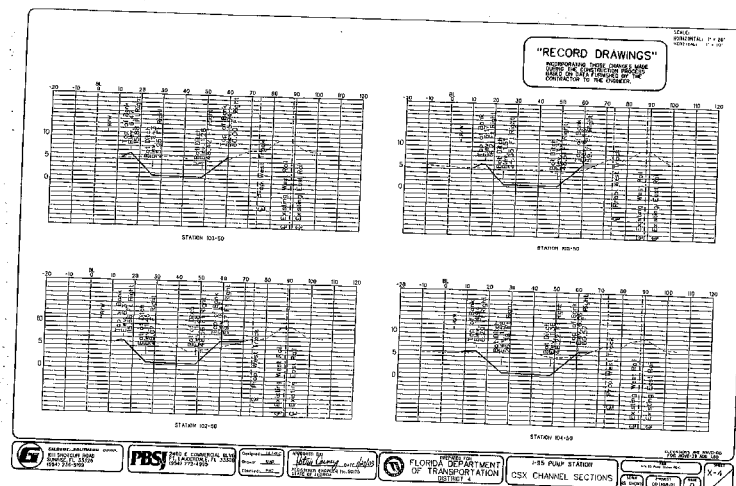
I-95 PUMP STATION
CSX CHANNEL SECTIONS

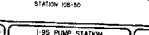
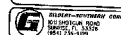
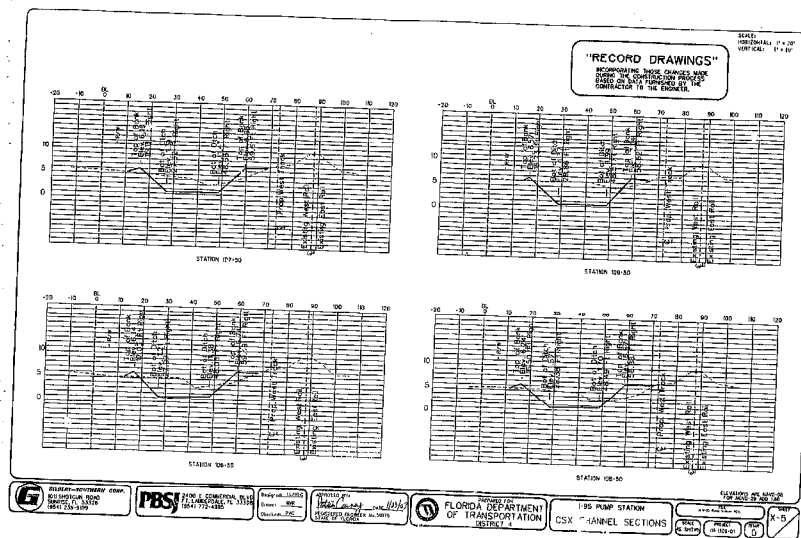
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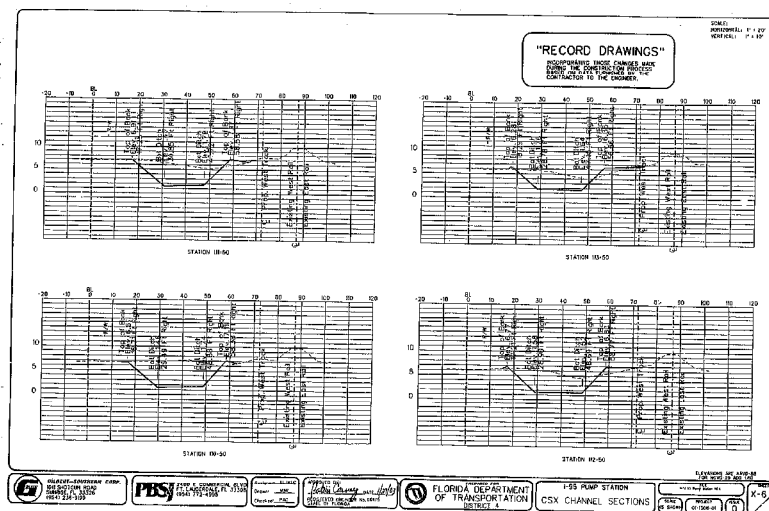
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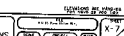
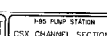
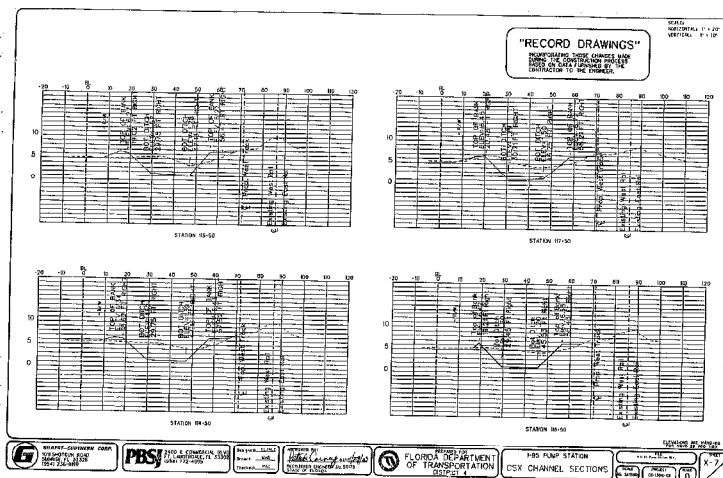
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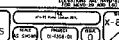
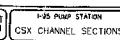
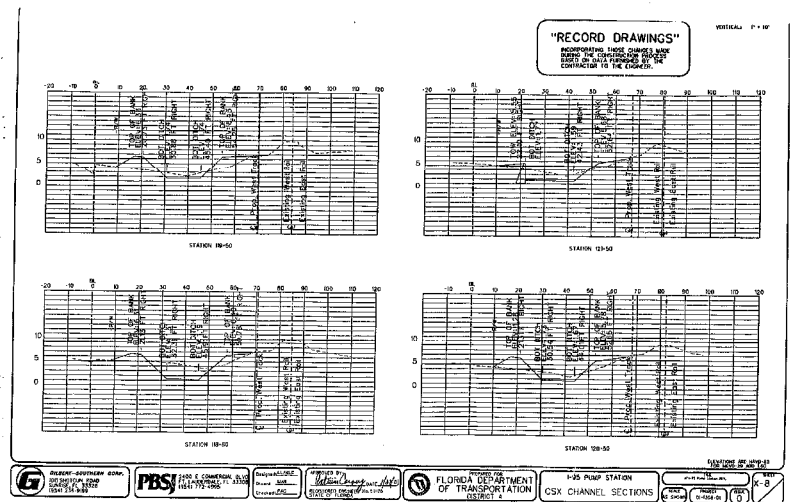
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"RECORD DRAWINGS"

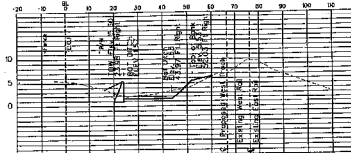
RECORDING THESE CHANNEL AND
BANK DATA ON THESE FORMS FOR
CONNECTION TO THE WORKSHEET

HORIZONTAL: 1" = 100'

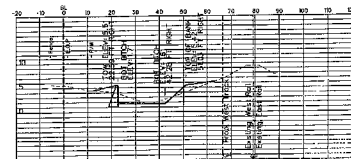
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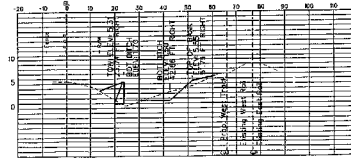
STATION 02+50



STATION 03+50

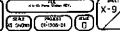
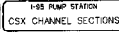


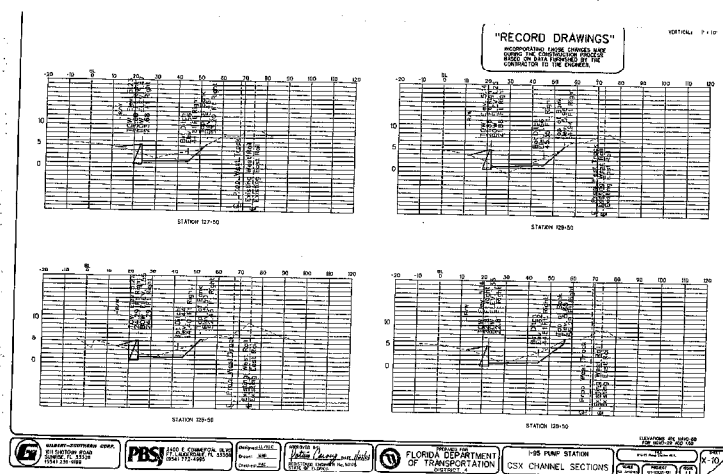
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STATION 05+50

STATION 06+50

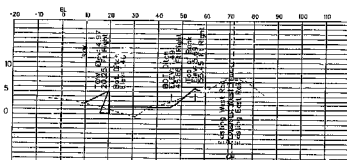




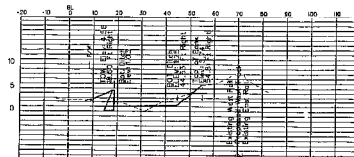
"RECORD DRAWINGS"

RECORDING 100% DIMENSIONS
BASED ON CONSTRUCTION RECORDS
SHOWN ON THIS DRAWING TO THE
CONTRACTOR TO THE ENGINEER.

VERIFIED P-107



STATION 121+50



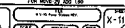
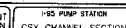
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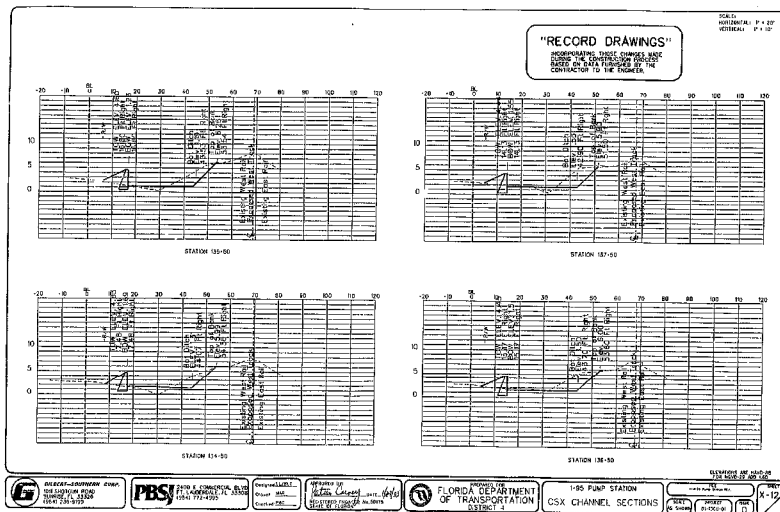


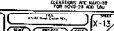
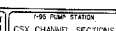
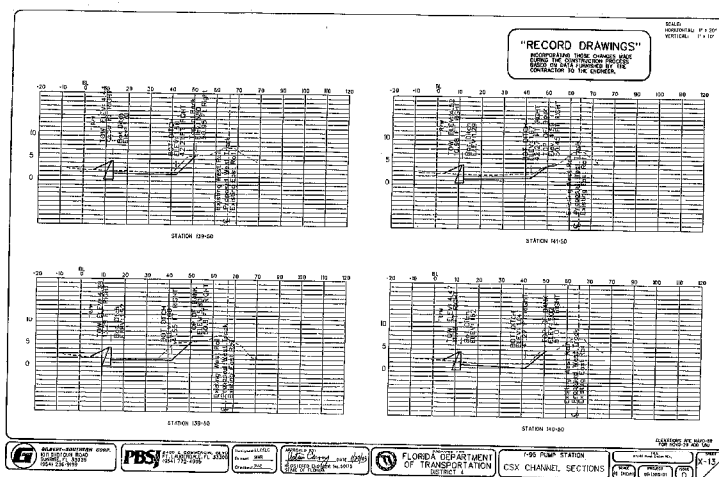
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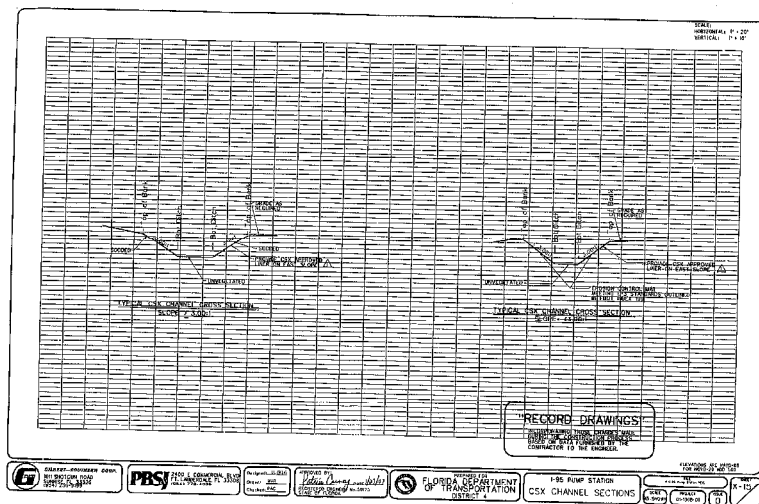


STATION 127+50









G GUYTON-ROCKWELL CORP.
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 1000-1000-1000

PBS 1000-1000-1000
 1000-1000-1000
 1000-1000-1000

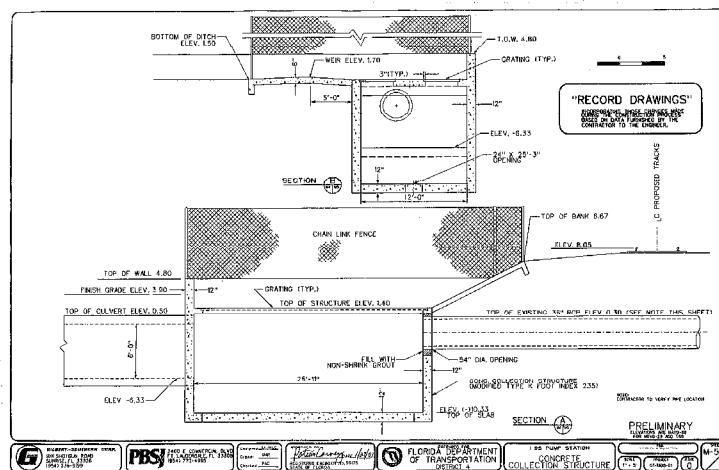
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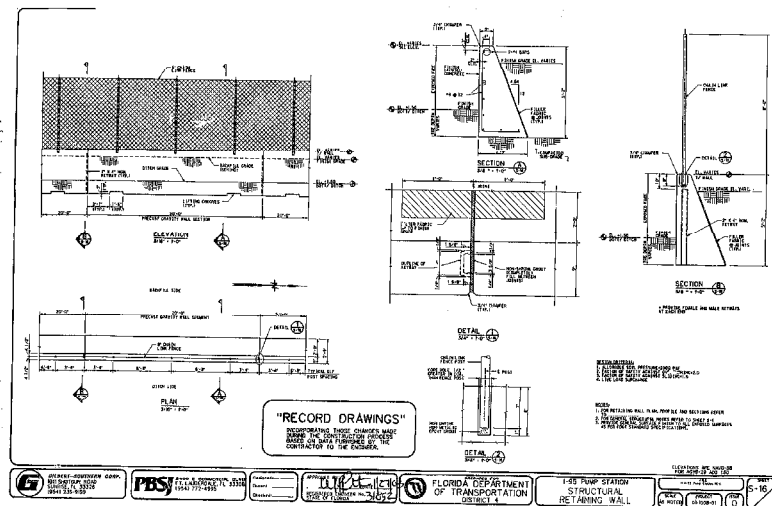
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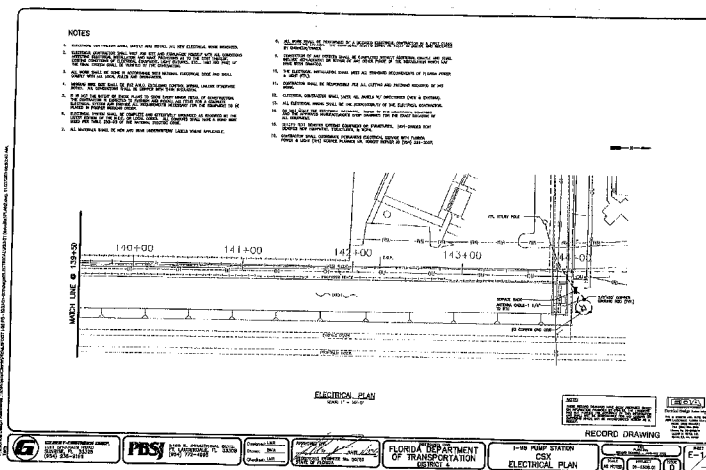
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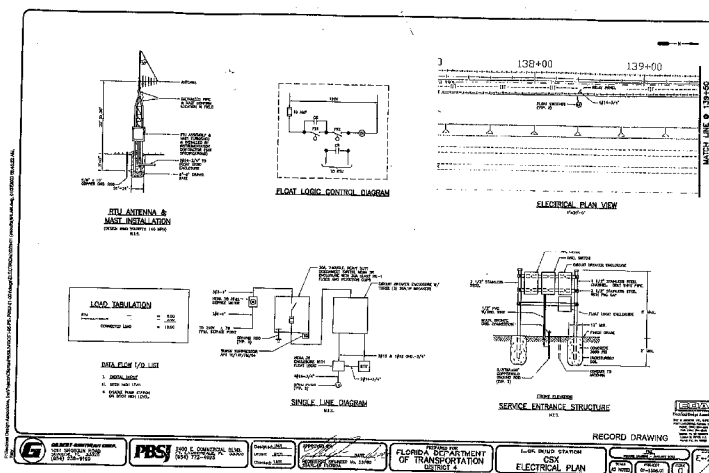
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1000-1000-1000









Attachment C

FDEP Permit



FLORIDA DEPARTMENT OF Environmental Protection

Southeast District Office
3301 Gun Club Road, MSC 7210-1
West Palm Beach, FL 33406
561-681-6600

Ron DeSantis
Governor

Jeanette Nuñez
Lt. Governor

Noah Valenstein
Secretary

October 18, 2019

In the Matter of an Application for Permit by:

City of Hallandale Beach
Mr. James Sylvain, P.E.
Director of Public Works
630 NW 2ND ST
Hallandale Beach, FL 33009

Sent by Email: jsylvain@COHB.org

DEP File No. 0131028-079-WC
Broward County
City of Hallandale Beach Well-9
PWS No.: 4060573

NOTICE OF PERMIT ISSUANCE

Enclosed is Permit Number 0131028-079-WC to add a new well, Well-9, to the City of Hallandale Beach, in Broward County, Florida. This permit is issued under Section(s) 403.087 of the Florida Statutes.

A person whose substantial interests are affected by the proposed permitting decision of the Department may petition for an administrative hearing in accordance with Sections 120.569 and 120.57 of the Florida Statutes.

The petition must contain the information set forth below and must be filed (received) in the Department of Environmental Protection, Office of General Counsel, Mail Station 35, 3900 Commonwealth Boulevard, Tallahassee, Florida, 32399-3000. Petitions filed by the permit applicant or any of the parties listed below must be filed within fourteen days of receipt of this notice of intent. Petitions filed by any other person must be filed within fourteen days of publication of the public notice or within fourteen days of receipt of this notice of intent, whichever occurs first. A petitioner must mail a copy of the petition to the applicant at the address indicated above, at the time of filing. The failure of any person to file a petition within the appropriate time period shall constitute a waiver of that person's right to request an administrative determination (hearing) under Sections 120.569 and 120.57 of the Florida Statutes, or to intervene in this proceeding and participate as a party to it. Any subsequent intervention will be only at the discretion of the presiding officer upon the filing of a motion in compliance with rule 28-5.207 of the Florida Administrative Code.

A petition must contain the following information:

- (a) The name, address, and telephone number of each petitioner; the Department permit identification number and the county in which the subject matter or activity is located;
- (b) A statement of how and when each petitioner received notice of the Department action;

- (c) A statement of how each petitioner's substantial interests are affected by the Department action;
- (d) A statement of the material facts disputed by the petitioner, if any;
- (e) A statement of facts that the petitioner contends warrant reversal or modification of the Department action;
- (f) A statement of which rules or statutes the petitioner contends require reversal or modification of the Department action; and
- (g) A statement of the relief sought by the petitioner, stating precisely the action that the petitioner wants the Department to take.

Because the administrative hearing process is designed to formulate final agency action, the filing of a petition means that the final action of the Department may be different from the position taken by it in this notice of intent. Persons whose substantial interests will be affected by any such final decision of the Department on the application have the right to petition to become a party to the proceeding, in accordance with the requirements set forth above.

Mediation under Section 120.573 of the Florida Statutes is not available for this proceeding.

This action is final on the date filed with the Clerk of the Department unless a petition is filed in accordance with the above. Upon the timely filing of a petition this order will not be effective until further order of the Department.

Any party to the order has the right to seek judicial review of the order under Section 120.68 of the Florida Statutes, by the filing of a notice of appeal under rule 9.110 of the Florida Rules of Appellate Procedure with the Clerk of the Department in the Office of General Counsel, 3900 Commonwealth Boulevard, Mail Station 35, Tallahassee, Florida, 32399-3000; and by filing a copy of the notice of appeal accompanied by the applicable filing fees with the appropriate district court of appeal. The notice of appeal must be filed within 30 days from the date when the final order is filed with the Clerk of the Department.

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STATE OF FLORIDA DEPARTMENT
OF ENVIRONMENTAL PROTECTION



John Kent Edwards
Program Administrator
Permitting and Waste Clean Up

JKE/CW/MP

CERTIFICATE OF SERVICE

The undersigned duly designated deputy clerk hereby certifies that this permit and all copies were sent on the filing date below to the following listed persons:

FDEP SED – Jocelyn.Labbe@FloridaDEP.Gov Mark.Peters@FloridaDEP.Gov
Hazen and Sawyer – George Brown, P.E. gbrown@hazenandsawyer.com
Broward County Health Department – Robyn.James@flhealth.gov

FILING AND ACKNOWLEDGMENT

FILED, on this date, pursuant to Section 120.52, F. S., with the designated Department Clerk, receipt of which is hereby acknowledged.



Clerk

October 18, 2019
Date

This space is intentionally left blank



FLORIDA DEPARTMENT OF Environmental Protection

Southeast District Office
3301 Gun Club Road, MSC 7210-1
West Palm Beach, FL 33406
561-681-6600

Ron DeSantis
Governor

Jeanette Nuñez
Lt. Governor

Noah Valenstein
Secretary

October 18, 2019

PERMITTEE:

City of Hallandale Beach
Mr. James Sylvain, P.E.
Director of Public Works
630 NW 2ND ST
Hallandale Beach, FL 33009
Sent by Email: jsylvain@COHB.org

PWS ID NUMBER: 4060573
PERMIT NUMBER: 0131028-079-WC
DATE OF ISSUE: October 18, 2019
EXPIRATION DATE: October 17, 2024
COUNTY: Broward
PROJECT: City of Hallandale Beach Well-9

This permit is issued under the provisions of Chapter 403, Florida Statutes (F.S.), and Florida Administrative Code (F.A.C.) Chapters 62-4, 62-550, 62-555 and 62-560. The above named permittee is hereby authorized to perform the work or operate the facility shown on the application and approved drawings, plans, and other documents attached hereto or on file with the Department and made a part hereof and specifically described as follows:

TO CONSTRUCT: Well-9 to serve the City of Hallandale Beach, a Community Public Water System

PROPOSED CONSTRUCTION INCLUDES:

New Well-9 public water supply well in the Biscayne Aquifer to supply the city of Hallandale Beach Water Treatment Plant for additional redundancy. It is a 24-inch diameter well, approximately 100 feet below land surface, equipped with a 2,200 gpm submersible pump and wellhead.

The following are the installed components:

VALMATIC Air Release Valve 1" NPT, Model 25.5
VALMATIC Well Service Air Valve Model 102ST
TECHNO In Well Check Valve Style 5002F-316
Singer valve Model 106-RPS; pressure relief valve
DeZURIK Wellhead Check Valve Model CRF-100SR
Goulds Vertical Turbine Pump Model VIS, 60Hz, RPM 1745, 153.8 hp; flow 2,200 gpm @235.0 TDH

IN ACCORDANCE WITH: The construction permit application, Preliminary Design Report, and Engineering Specifications dated September 13, 2019 prepared by George Brown, P.E. of Hazen and Sawyer, Inc. and received by the Department on October 14, 2019.

LOCATED AT: West Side of 430 Ansin Blvd. between Pembroke Road and Hallandale Blvd, in Hallandale Beach, Florida

Latitude: 25° 59' 24.57"N

Longitude: 80° 9' 55.27"W

TO SERVE: City of Hallandale Beach Water Treatment Plant.

Work must be conducted in accordance with the General and Specific Conditions, attached hereto.

Issued this 18th day of October, 2019

STATE OF FLORIDA DEPARTMENT
OF ENVIRONMENTAL PROTECTION



John Kent Edwards
Program Administrator
Permitting and Waste Clean Up

JKE/CW/MP

Attachments: General Conditions, Regulatory Section, Construction Standards, Operational Requirements, Monitoring Provisions, Clearance Requirements

Electronic Copies Furnished to:

FDEP SED – Jocelyn.Labbe@FloridaDEP.Gov Mark.Peters@FloridaDEP.Gov

Hazen and Sawyer – George Brown, P.E. gbrown@hazenandsawyer.com

Broward County Health Department – Robyn.James@flhealth.gov

A. General Conditions

The permittee shall be aware of and operate under the Permit Conditions below. These applicable conditions are binding upon the permittee and enforceable pursuant to Chapter 403, Florida Statutes. [FAC Rule 62-555.533(1)]

1. The terms, conditions, requirements, limitations and restrictions set forth in this permit, are "permit conditions" and are binding and enforceable pursuant to Sections 403.141, 403.727, or 403.859 through 403.861, FS. The permittee is placed on notice that the Department will review this permit periodically and may initiate enforcement action for any violation of these conditions.
2. This permit is valid only for the specific processes and operations applied for and indicated in the approved drawings or exhibits. Any unauthorized deviation from the approved drawings, exhibits, specifications, or conditions of this permit may constitute grounds for revocation and enforcement action by the Department.
3. As provided in Subsections 403.087(6) and 403.722(5), FS, the issuance of this permit does not convey any vested rights or any exclusive privileges. Neither does it authorize any injury to

public or private property or any invasion of personal rights, nor any infringement of federal, state, or local laws or regulations. This permit is not a waiver of or approval of any other department permit that may be required for other aspects of the total project which are not addressed in this permit.

4. This permit conveys no title to land or water, does not constitute State recognition or acknowledgment of title, and does not constitute authority for the use of submerged lands unless herein provided and the necessary title or leasehold interests have been obtained from the State. Only the Trustees of the Internal Improvement Trust Fund may express State opinion as to title.
5. This permit does not relieve the permittee from liability for harm or injury to human health or welfare, animal, or plant life, or property caused by the construction or operation of this permitted source, or from penalties therefore; nor does it allow the permittee to cause pollution in contravention of Florida Statutes and Department rules, unless specifically authorized by an order from the Department.
6. The permittee shall properly operate and maintain the facility and systems of treatment and control (and related appurtenances) that are installed and used by the permittee to achieve compliance with the conditions of this permit, as required by Department rules. This provision includes the operation of backup or auxiliary facilities or similar systems when necessary to achieve compliance with the conditions of the permit and when required by Department rules.
7. The permittee, by accepting this permit, specifically agrees to allow authorized Department personnel, upon presentation of credentials or other documents as may be required by law and at reasonable times (reasonable time may depend on the nature of the concern being investigated), access to the premises where the permitted activity is located or conducted to:
 - a. Have access to and copy any records that must be kept under conditions of the permit;
 - b. Inspect the facility, equipment, practices, or operations regulated or required under this permit; and
 - c. Sample or monitor any substances or parameters at any location reasonably necessary to assure compliance with this permit or Department rules.
8. If, for any reason, the permittee does not comply with or will be unable to comply with any condition or limitation specified in this permit, the permittee shall immediately provide the Department with the following information:
 - a. A description of and cause of noncompliance; and
 - b. The period of noncompliance, including dates and times; or, if not corrected, the anticipated time the noncompliance is expected to continue, and steps being taken to reduce, eliminate, and prevent recurrence of the noncompliance. The permittee shall be responsible for any and all damages which may result and may be subject to enforcement action by the Department for penalties or for revocation of this permit.
9. In accepting this permit, the permittee understands and agrees that all records, notes, monitoring data and other information relating to the construction or operation of this permitted source which are submitted to the Department may be used by the Department as evidence in any enforcement case involving the permitted source arising under the Florida Statutes or Department rules, except where such use is prescribed by Sections 403.111 and

403.73, FS Such evidence shall only be used to the extent it is consistent with the Florida Rules of Civil Procedure and appropriate evidentiary rules.

10. The permittee agrees to comply with changes in Department rules and Florida Statutes after a reasonable time for compliance; provided, however, the permittee does not waive any other rights granted by Florida Statutes or Department rules. A reasonable time for compliance with a new or amended surface water quality standard, other than those standards addressed in Rule 62-302.500, shall include a reasonable time to obtain or be denied a mixing zone for the new or amended standard.
11. This permit is transferable only upon Department approval in accordance with Rule 62- 4.120 and 62-730.300, FAC, as applicable. The permittee shall be liable for any non-compliance of the permitted activity until the transfer is approved by the Department.
12. This permit or a copy thereof shall be kept at the work site of the permitted activity.
13. This permit also constitutes:
 - a. Determination of Best Available Control Technology (BACT)
 - b. Determination of Prevention of Significant Deterioration (PSD)
 - c. Certification of compliance with State Water Quality Standards (Section 401, PL 92-500)
 - d. Compliance with New Source Performance Standards
14. The permittee shall comply with the following:
 - a. Upon request, the permittee shall furnish all records and plans required under Department rules. During enforcement actions, the retention period for all records will be extended automatically unless otherwise stipulated by the Department.
 - b. The permittee shall hold at the facility or other location designated by this permit records of all monitoring information (including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation) required by the permit, copies of all reports required by this permit, and records of all data used to complete the application for this permit. These materials shall be retained at least three years from the date of the sample, measurement, report, or application unless otherwise specified by Department rule.
 - c. Records of monitoring information shall include:
 - i. the date, exact place, and time of sampling or measurements;
 - ii. the person responsible for performing the sampling or measurements;
 - iii. the dates analyses were performed;
 - iv. the person responsible for performing the analyses;
 - v. the analytical techniques or methods used;
 - vi. the results of such analyses.
15. When requested by the Department, the permittee shall within a reasonable time furnish any information required by law which is needed to determine compliance with the permit. If the permittee becomes aware the relevant facts were not submitted or were incorrect in the permit

application or in any report to the Department, such facts or information shall be corrected promptly.

B. Regulatory Section

1. All construction must be in accordance with this permit. Before commencing work on project changes for which a construction permit modification is required per 62-555.536(1), the permittee shall submit to the Department a written request for a permit modification. Each such request shall be accompanied by one copy of a revised construction permit application, the proper processing fee and one copy of either a revised preliminary design report or revised drawings, specifications and design data. [FAC Rule 62-555.536].
2. If prehistoric or historic artifacts, such as pottery or ceramics, stone tools or metal implements, dugout canoe remains, or any other physical remains that could be associated with Native American cultures, or early colonial or American settlement are encountered at any time within the project site area, the permitted project should cease all activities involving subsurface disturbance in the immediate vicinity of such discoveries. The permittee, or other designee, should contact the Florida Department of State, Division of Historical Resources, Compliance and Review Section at 850.245.6333 or 800.847.7278, as well as the appropriate permitting agency office. Project activities should not resume without verbal and/or written authorization from the Division of Historical Resources and the permitting agency. In the event that unmarked human remains are encountered during permitted activities, all work shall stop immediately and the proper authorities notified in accordance with Section 872.05, *Florida Statutes*.
3. If delays will cause project completion to extend beyond the expiration date of this permit, the permittee shall submit to the Department a request to extend the expiration date of this permit including the appropriate processing fee. This request shall specify the reasons for the delay and shall be submitted to the Department for approval prior to the expiration date of this permit. Note that no specific construction permit shall be extended so as to remain in effect longer than five years. [FAC Rule 62-555.536(4)]. {OPTIONAL}
4. In accordance with General Condition #11 of this permit, this permit is transferable only upon Department approval. Persons proposing to transfer this permit must apply jointly for a transfer of the permit within 30 days after the sale or legal transfer of ownership of the permitted project that has not been cleared for service by the Department using form, 62-555.900(8), Application for Transfer of a PWS Construction Permit along with the appropriate fee. [FAC Rule 62-555.536(5)]
5. This permit satisfies Drinking Water permitting requirements only and does not authorize construction or operation of this facility prior to obtaining all other necessary permits from other program areas within the Department, or required permits from other state, federal, or local agencies.
6. If gasoline contamination is found at the construction site, work shall be stopped and the proper authorities notified. With the approval of the Department, ductile iron pipe and fittings, and solvent resistant gaskets materials shall be used in the contaminated area. The ductile pipe shall be used in the contaminated area. The ductile iron pipe shall extend 100 feet beyond any solvent noted. Any contaminated soil that is excavated shall be placed on an impermeable mat, covered

with waterproof covering, and held for disposal. If the site cannot be properly cleaned, then consultation with the Department is necessary prior to continuing with the project construction.

7. This permit does not constitute approval of construction on jurisdictional wetland areas; therefore, such approval must be obtained separately from the Water Management District or from the Department of Environmental Protection Environmental Resource Permitting (DEP ERP) Program, as applicable. The permittee shall provide a copy of the permit approval to the Department if water main installation involves activities on wetlands.
8. Permittee shall ensure that the well and drinking water treatment facilities will be protected to prevent tampering, vandalism, and sabotage as required by Rule 62-555.315(1) & 62-555.320(5), F.A.C.

C. Construction Standards

1. All products, including paints, which shall come into contact with potable water, either directly or indirectly, shall conform to National Sanitation Foundation (NSF) International, Water Chemicals Codex, Food Chemicals Codex, American Water Works Association (AWWA) Standards and the Food and Drug Administration, as provided in Rule 62-555.320(3), FAC.
2. Water supply facilities, including mains, pipe, fittings, valves, fire hydrants and other materials shall be installed in accordance with the latest applicable AWWA Standards and Department rules and regulations. The system shall be pressure and leak tested in accordance with AWWA Standard C600 C603, or C605, as applicable, and disinfected in accordance with AWWA Standard C651-653, as well as in accordance with Rule 62-555.340, FAC
3. The installation or repairs of any public water system, or any plumbing in residential or nonresidential facilities providing water for human consumption, which is connected to a public water system shall be lead free in accordance with Rule 62-555.322, FAC
4. Setback distances between potable water wells and sanitary hazards shall be in accordance with 62-555.312, F.A.C.
5. The new or altered aboveground piping at the drinking water treatment plant shall be color coded and labeled as recommended in Section 2.14 of "Recommended Standards for Water Works," 1997 Edition. [FAC Rule 62-555.320(10)]
6. Permittee shall ensure that there shall be no cross-connection with any non-potable water source in accordance with Rule 62-555.360, FAC

D. Operational Requirements

1. The facility has been classified as a Category 1, Class A water treatment plant. Accordingly, the lead or chief operator must be Class A. Proof of staffing by a Class A must be provided. [F.A.C. Rule 62-699.310]
2. The supplier of water shall operate and maintain the public water system so as to comply with applicable standards in FAC Rule 62-550 and 62-555.350.
3. The permittee shall provide an operation and maintenance manual for the new or altered treatment facilities to fulfill the requirements under subsection 62-555.350(13), FAC. The

manual shall contain operation and control procedures, and preventative maintenance and repair procedures, for all plant equipment and shall be made available for reference at the plant or at a convenient location near the plant. Bound and indexed equipment manufacturer manuals shall be considered sufficient to meet the requirements of the subsection.

4. The permittee shall submit a monthly operations report (MOR) DEP Form 62-555.900(x), to the Department no later than the tenth of each succeeding month. (Note: (x) depends upon type of treatment)
5. The permittee shall have complete record drawings produced for the project in accordance with Rule 62-555.530(4), FAC.
6. The permittee or suppliers of water shall telephone the State Warning Point (SWP), at 1-800-320-0519 immediately (i.e., within two hours) after discovery of any actual or suspected sabotage or security breach, or any suspicious incident, involving a public water system in accordance with the FAC Rule 62-555.350(10).

E. Monitoring Provisions

1. Permittee shall follow the guidelines of Chapters 62-550, 62-555, and 62-560, FAC, regarding public drinking water system standards, monitoring, reporting, permitting, construction, and operation.

This facility is a **Community Water System** as defined in F.A.C. Rule 62-550.200 and shall comply with all monitoring requirements of F.A.C. Chapter 62-550.

2. The water treatment plant shall maintain throughout the distribution system a minimum continuous and effective free chlorine residual of 0.2 mg/l or its equivalent. A minimum system pressure of 20 psi must be maintained throughout the system. Also, safety equipment shall be provided and located outside of chlorine room.

OR

The water treatment plant shall maintain throughout the distribution system a minimum combined chlorine residual of 0.6 mg/l or its equivalent. A minimum system pressure of 20 psi must be maintained throughout the system. Also, safety equipment shall be provided and located outside of chlorine room.

F. Clearance Requirements

1. The permittee must instruct the engineer of record to request system clearance from the Department within sixty (60) days of completion of construction, testing and disinfecting the system. Bacteriological test results shall be considered unacceptable if the test were completed more than 60 days before the Department received the results. [FAC Rule 62-555.340(2)(c)]

Permitted construction or alteration of a public water system may not be placed into service until a letter of clearance has been issued by this Department. [FAC Rule 62-555.345]

2. Prior to placing this project into service, Permittee shall submit, at a minimum, all of the following to the Department for evaluation and approval for operation, as provided in Rules 62-555.340 and 62-555.345, FAC:

- a. the engineer's *Certification of Construction Completion and Request for Clearance to Place Permitted PWS Components Into Operation* {DEP Form 62-555.900(9)};
- b. Certified record drawings, if there are any changes noted for the permitted project.

In order to facilitate the issuance of a letter of clearance, the Department requests that all of the above information be submitted as one package

Attachment D

FDOT Permit

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION
GENERAL USE PERMIT

Date: 9/16/2019 Permit No.: 2019-K-491-00111

Name of Applicant or Authorized Agent: LUCIA MEDINA

Entity (if applicable): City of Hallandale Beach

(If entity, furnish contact information for responsible representative)

Address: 4000 Hollywood Boulevard, 750N, North Tower Zip Code: 33021

City/State: Hollywood, Florida Telephone No.: (954) 987-0066 ext. _____

Email Address: lmedina@hazenandsawyer.com

Activity / Project Site

County: Broward State Road: SR 9 Section: 070, 000

From Mile Post: 0.773 to Mile Post: 1.430

Construction Proposed or Underway: Yes ☐ No ☐ FM Project No.: _____

Name of Municipality if Work is within Limits: City of Hallandale Beach

Description of Work Activity:

The City is proposing a production well to supply the City's Water Treatment Plant. The new well, PW-9, is expected to discharge a total of 30 million gallons at a rate of 4,000 gpm during the start-up testing. The City requires a temporary connection to an existing 84-inch stormwater pipe, conveying the well's discharge to an existing FDOT pump station (ERP No.06-02942-P).

General Provisions

1. Attach any pertinent plans or drawings.
2. Attach notification letters sent to any Utilities both aerial and underground that will be potentially impacted.
3. The designated FDOT Engineer shall be notified 48 hours prior to beginning of work.
Contact Allien Dessalines at 9549547632.
4. All work, materials and equipment shall be subject to inspection and approval by FDOT. Applicants certification of work at completion is required.
5. The permittee shall be responsible to place and display safety devices and proper maintenance of traffic in accordance with the latest version of the Department's Design Standards, index series 600, or an alternative plan signed and sealed by a professional Engineer and attached with the permit.
6. All FDOT property shall be restored to its original condition. Any damage to FDOT property as a result of this work shall be repaired and restored in a manner acceptable to the FDOT at the sole expense of the permittee.

Approved
2019-K-491-00111
Valerie Garland
10/3/2019

Special Provisions

Please call for a preconstruction meeting and final inspection. Broward Operations (954)776-4300.2.A copy permit and plans will be on the job site at all times. Permittee shall notify the FDOT a minimum of 2 work days prior to starting work and again immediately upon completion. Failure to comply with these conditions will result in the Permit being revoked.

Conditions

1. In the event the permittee fails to meet any of the requirements of this permit by the FDOT, the permitted activity must cease until brought into compliance. If compliance can not be met, then the permit will be rendered void and said work shall be removed from the right of way at no cost to the FDOT.
2. Work shall commence within 270 days of permit approval.
Work shall be completed by 7/31/2020.
(Date)
3. The rights and privileges herein set out are granted only to the extent of the State's right, title and interest in the land to be entered upon and used by the permittee, and the permittee will, at all times, and to the extent permitted by law, assume all risk of and indemnify, defend and save harmless the State of Florida and the FDOT from and against any and all loss, damage, cost or expense arising in any manner on account of the exercise or attempted exercises by said permittee of the aforesaid rights and privileges.

Applicant

I hereby agree to comply with all terms and conditions set forth and described in this permit.

LUCIA MEDINA, Principal Engineer

LUCIA MEDINA

9/16/2019

Printed or Typed Name and Title

Signature

Date

FDOT

Approved By:

Valerie Garland

Valerie Garland

10/3/2019

Print Designated Engineer

Signature

Date

PERMITS COORDINATOR II

Title

Approved
2019-K-491-00111
Valerie Garland
10/3/2019

Special Conditions:

Please call for a preconstruction meeting and final inspection. Broward Operations (954)776-4300

1. Permittee is cautioned that utilities may be located within the construction area.
2. A copy of this permit and plans will be on the job site at all times during the construction of this facility
3. Permittee must schedule a pre-construction meeting with FDOT prior to the commencement of permitted work and prior to Lane closure request.
4. Lane closure request at <https://lcis.dot.state.fl.us/>. Must be submitted 14 days prior to date of closure. Lane closure hours are from 9:00am to 4:00pm. Night time lane closure can be requested only between the hours of 9:00pm to 5:00am.
5. Permittee shall notify the FDOT a minimum of 2 work days prior to starting work and again immediately upon completion work. Contact Emails are: Vikrant.Srivastava@dot.state.fl.us; Don.Preston@dot.state.fl.us; Valerie.Garland@dot.state.fl.us; Anthony Beecher Anthony.Beecher@dot.state.fl.us; Imhotep Duncanson Imhotep.Duncanson@dot.state.fl.us; Allien Dessalines Allien.Dessalines@dot.state.fl.us; Reveleno Bamberry Reveleno.Bamberry@dot.state.fl.us
6. Failure to comply with these conditions will result in the Permit being revoked.

Approved
2019-K-491-00111
Valerie Garland
10/3/2019

